2017

Clean Venice: Infrastructure & Place-Making in Venice, Italy

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CLEAN VENICE

INFRASTRUCTURE AND PLACE-MAKING IN VENICE, ITALY

CLEAN **VENICE**

GRADUATE THESIS PROJECT SUBMITTED TO:
ROGER WILLIAMS UNIVERSITY, SCHOOL OF ARCHITECTURE, ART & HISTORIC PRESERVATION
IN FULFILLMENT OF THE REQUIREMENTS OF THE M. ARCH DEGREE IN ARCHITECTURE
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ROGER WILLIAMS UNIVERSITY
SCHOOL OF ARCHITECTURE, ART & HISTORIC PRESERVATION

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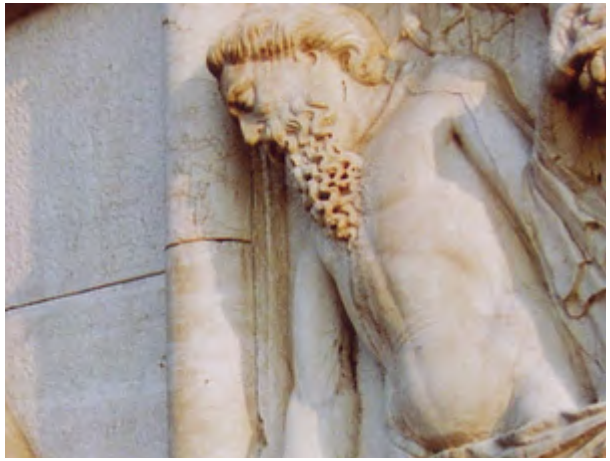
1.

INTRODUCTION

VENICE IS DETERIORATING. THE FRAGILE CITY IS CRUMBLING, AND EVENTUALLY WILL BE SWALLOWED INTO THE WATER WHICH SURROUNDS IT. BESIDES THE PROSPECT OF SINKING, THE INFRASTRUCTURE IS DAMAGED WEEKLY BY THE CRUISE SHIPS WHICH VISIT THE CITY AND ACCOUNT FOR ABOUT 2 MILLION TOURISTS EVERY YEAR. TYPICALLY, THESE SHIPS PRODUCE 50 TONS OF GARBAGE, 210,000 GALLONS OF SEWAGE, AND 35,000 GALLONS OF OIL-CONTAMINATED WATER. THAT BEING SAID, THESE FLOATING CITIES CONTRIBUTE TO ABOUT 20% OF HARMFUL EMISSIONS IN COASTAL AND PORT CITIES. IN AN ALREADY DAMAGED STATE, VENICE IS NEGATIVELY AFFECTED BY TRAFFIC AND POLLUTION FROM THESE VESSELS. RECENTLY, THE VENETIAN PRIME MINISTER ANNOUNCED THAT VENICE PLANS TO LIMIT, AND EVENTUALLY BAN THESE SHIPS FROM ENTERING THE LAGOON. BY HINDERING THE ACCESS OF THESE SHIPS, VENICE WILL SUFFER ECONOMICALLY; WHILE THE CITY WILL DELAY IT'S INEVITABLE FATE. THIS PROJECT EXPLORES THE TREATMENT AND RECYCLING OF WASTE PRODUCED BY THESE CRUISE SHIPS AS A WAY TO BETTER THE ECOSYSTEM IN VENICE; WHILE ALSO CREATING A VALUABLE GREEN SPACE WITHIN THE CONGESTED CITY. SUSTAINABILITY IS THE FUTURE OF ARCHITECTURE; HOWEVER, SUSTAINABLE OPTIONS FREQUENTLY ACT AS APPENDAGES IN THE DESIGN PROCESS. ARCHITECTURAL DESIGN AND SUSTAINABILITY SHOULD WORK IN TANDEM, AND THUS COMMUNICATE THEIR PURPOSE IN REAL TIME. THIS PROJECT EXPLORES A CREATIVE OUTLOOK ON SUSTAINABLE ARCHITECTURE WHILE ALSO EXTENDING THE EDUCATION AND UNDERSTANDING OF SUSTAINABLE ELEMENTS IN MOTION.

2.

SITE HISTORY




VENETIA.
MVRAN.
CANAL DELLA GIVDECA
LA GIVDECA
S. Georgio Maggiore

45*26’15”N 12*20’9”E

VENICE IS LOCATED IN NORTHEASTERN ITALY. VENICE IS MADE UP OF 118 INDIVIDUAL ISLANDS SEPARATED BY CANALS AND LINKED WITH BRIDGES. VENICE IS POPULATED BY 270,000 PEOPLE, NOT INCLUDING THE MILLIONS OF PEOPLE OF VISIT VENICE ANNUALLY. RENOWNED FOR ITS BEAUTIFUL SETTING, INCREDIBLE ARCHITECTURE AND RICH HISTORY,

ALTHOUGH THERE IS NO CLEAR HISTORICAL RECORD OF THE FOUNDING OF VENICE, HISTORIANS IDENTIFY THE BIRTH OF VENICE WITH THE DEDICATION OF THE CHURCH, SAN GIACOMO, IN MARCH 421. LOCATED ON THE ADRIATIC SEA, VENICE DOMINATED MEDITERRANEAN ECONOMY, TRADING WITH THE BYZANTINE EMPIRE AND THE MUSLIM WORLD.

HISTORICALLY, THE BIGGEST THREAT TO THE CITY IS THE FLOOD TIDES PUSHED IN FROM THE ADRIATIC SEA. DURING THE 20TH CENTURY, ARTESIAN WELLS WERE SUNK INTO THE LAGOON TO DRAW WATER FOR LOCAL INDUSTRY. DURING THIS EXTRACTION, VENICE BEGAN SINKING MORE RAPIDLY. IN THE 1960’S, THESE WELLS WERE BANNED AND THE SINKING SLOWED DOWN. HOWEVER, HIGH WATER STILL THREATENS THE CITY, FLOODING THE GROUND FLOOR OF THE CITY DURING LOW-LEVEL FLOODS. VENICE HAS MADE SOME ATTEMPTS TO HINDER THE FLOODS; FOR INSTANCE, THE MOSE PROJECT, INTRODUCED IN 2003, IS AN EXPERIMENTAL MODEL WHICH EVALUATES FLOODING WITH THE ADDITION OF HOLLOW FLOATABLE GATES.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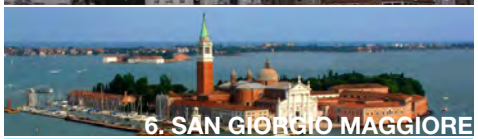
1. TRONCETTO


2. UNIVERSTA IUAV DI VENEZIA


3. CALATRAVA BRIDGE


4. PIAZZA SAN MARCO

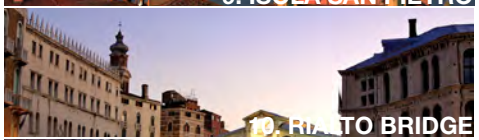

5. BASILICA DI SANTA MARIA DELLA SALUTE

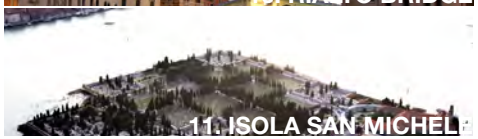

6. SAN GIORGIO MAGGIORE


7. SANT'ELENA

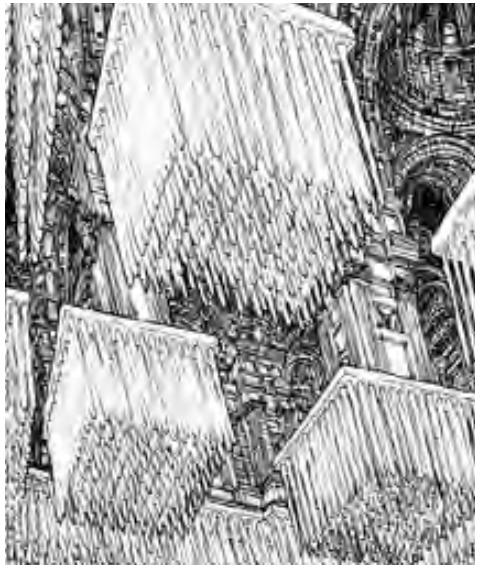

8. LA BIENNALE DI VENEZIA-GIARDINI

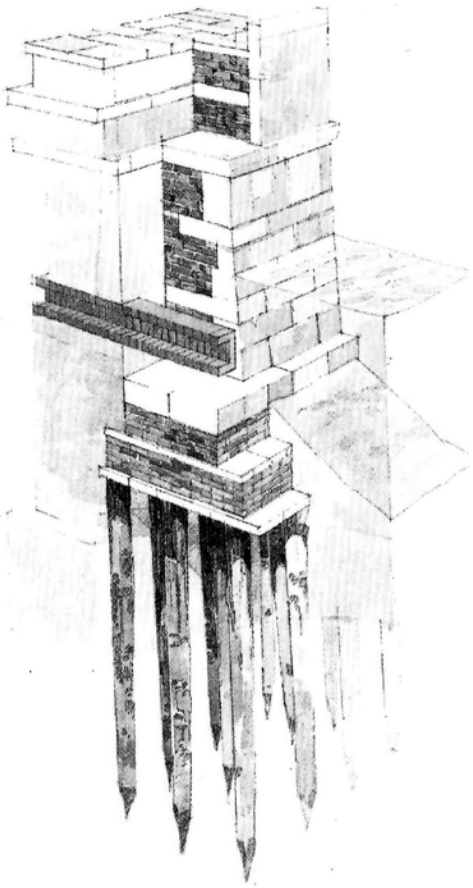

9. ISOLA SAN PIETRO


10. RIALTO BRIDGE


11. ISOLA SAN MICHEL

IMPORTANT PLACES

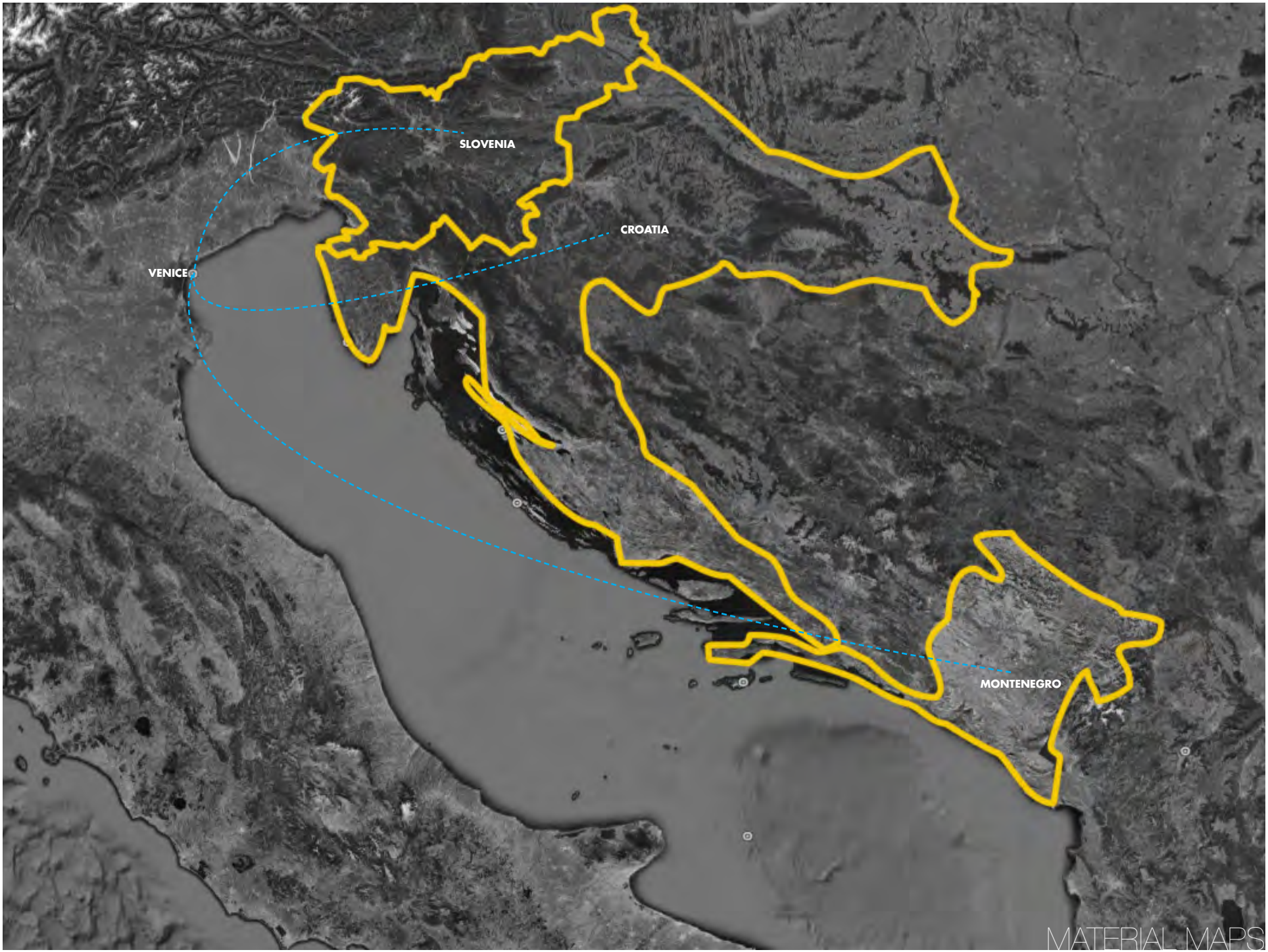




The foundations of the buildings in Venice
(Stefano Zanovello, from drawing of Mario Piana)

HISTORICALLY, THE VENICE LAGOON WAS MADE UP OF A COLLECTION OF SMALL ISLANDS OF ROCK AND MUD. IT WAS HERE THE PEOPLE WHO FOUNDED VENICE BEGAN DRIVING WOOD PILINGS INTO THE MUD AND SAND INTO CLAY. THESE PILINGS BECAME THE INITIAL FOUNDATION. THE WOOD WAS GATHERED IN FORESTS FAR AWAY IN CROATIA, SLOVENIA AND MONTENEGRO. THE TIMBER WAS THEN TRANSPORTED BY WATER TO VENICE. ONCE ALL THE PILINGS WERE DRIVEN INTO THE CLAY, HORIZONTAL MEMBERS WERE LAID, AND THEN A STONE FOUNDATION PLACED ON THE HORIZONTAL MEMBERS. FROM THERE THE BUILDINGS WERE BUILT USING WOOD FRAMING CONSTRUCTION TECHNIQUES OR BRICK.

ALTHOUGH MOST OF THE FOUNDATIONS ARE COMPLETELY SUBMERGED, THE BUILDINGS OF VENICE STILL SIT ABOVE CLOSELY SPACED WOODEN PILES. THESE PILES ARE CONSTRUCTED FROM ALDER TREES WHICH ARE KNOWN FOR THEIR WATER-RESITANCE. MAKE UP MOST OF THESE WOODEN PILES, AND ALTHOUGH SUBMERGED, THE OXYGEN POOR CONDITIONS DELAYS THE DECAY SLOWER THAN IT WOULD ABOVE THE SURFACE. THE FOUNDATIONS REST ON THE PILES, AND THE BUILDINGS SIT ON THE FOOTINGS.



MATERIAL_MAPS

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1. BAROQUE STYLE

THE CA'REZZONICO IS A PALAZZO ON THE GRAND CANAL IN VENICE. THIS ARCHITECTURE EMPHASIZES BOLD MASSING, COLONNADES, DOMES, VOLUME AND VOID, AND RICH AND COLORFUL INTERIORS.

2. RENAISSANCE STYLE

THE CHURCH OF SAN GIORGIO MAGGIORE IS A 16TH CENTURY BENEDICTINE CHURCH DESIGNED BY ANDREA PALLADIO. THIS ARCHITECTURE EMPHASIZES SYMMETRY, PROPORTION, GEOMETRY, AND THE REGULARITY OF PARTS.

3. GOTHIC STYLE

THE PALAZZO DUCALE AT PIAZZA SAN MARCO SERVED AS THE RESIDENCE OF THE DOGE OF VENICE, THE SUPREME AUTHORITY OF VENICE. IN 1923, IT WAS TURNED INTO A MUSEUM. THE GOTHIC SYTLE IN ITALY EMPHASIZES THE POLYCHOME DECORATION, AND THE LANCET ARCH.

3.

SITE ANALYSIS

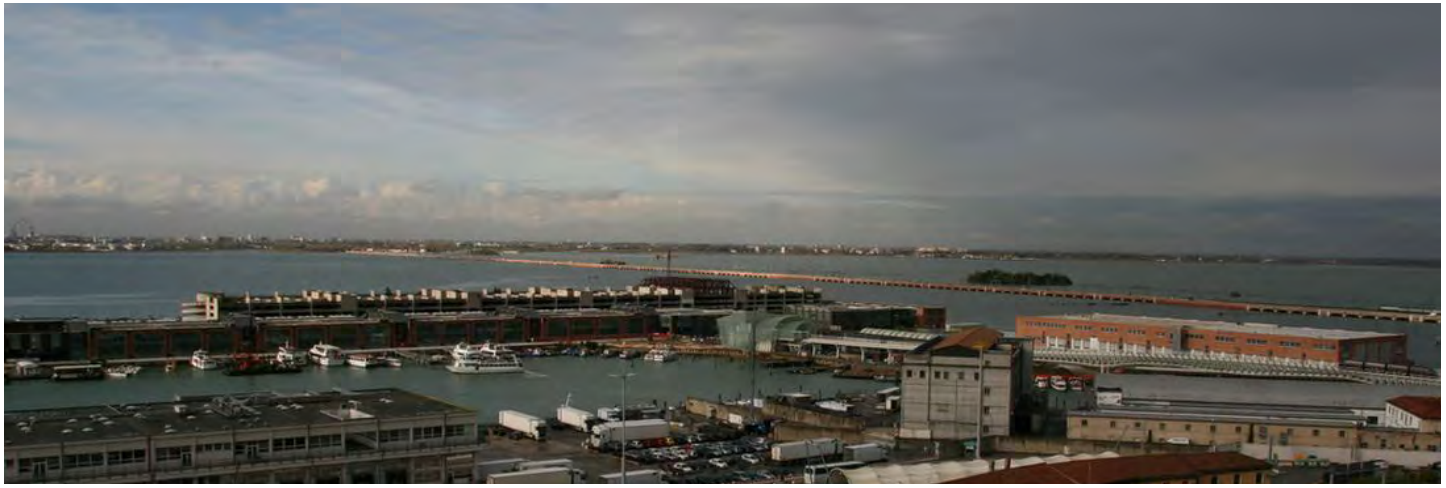

CANAL
DELLA
GIUDECCA
PIANTA TOPOGRAFICA DELLA R.ª CITTA DI VENEZIA
CON ZIZ DE SUOI
PRINCIPALI PROSPETTI

AFTER CAREFUL CONSIDERATION, THE SITE IN VENICE, ITALY WAS CHOSEN BECAUSE OF 3 MAJOR FACTORS.

FIRST, GIVEN THE PROGRAM AT HAND, THIS TYPE OF PROJECT WOULD FLOURISH IN AN AREA LIKE VENICE WHERE TOURISM OUTNUMBERS TOTAL POPULATION. THE EXPOSURE FROM OUTSIDE PERSONS MAY RAISE AWARENESS AND PROMOTE CHANGE.

SECOND, THE PIER TYPE LOCATION HAS BEEN ZONED SPECIFICALLY FOR SPECIAL USES - CURRENTLY THE MASSIVE MAN MADE PENINSULA SERVES AS CRUISE SHIP TERMINAL IN THE SANTA CROCE AREA OF VENICE. THIS AREA SPECIFICALLY SERVES TRANSPORTATION. VENICE IS PEDESTRIAN ONLY, VEHICLES OF ALL TYPES ARE RESTRICTED TO THIS CERTAIN AREA. THIS SITE SPECIFICALLY HAS ACCESS TO WATER FOR CRUISE SHIPS, BARGES, AND GONDOLAS. IT ALSO CAN BE APPROACHED BY FOOT AND BY CAR.

LASTLY, GIVEN THE CONSTRUCTION AND AESTHETIC OF THE SITE, THIS PROJECT TYPE CAN BE DESIGNED OUTSIDE OF HISTORIC GUIDELINES. WHILE MY DESIGN WILL WORK INTO THE HISTORIC FABRIC, THE OPTION TO CREATE SOMETHING THAT IS A HAPPY MARRIAGE BETWEEN MODERN IDEALS AND HISTORIC VERNACULAR LENDS THIS PROJECT TO CREATE ITS OWN LANGUAGE WITHIN THE GUIDELINES OF THE CITY OF VENICE.




BRILLIANCE OF THE SEAS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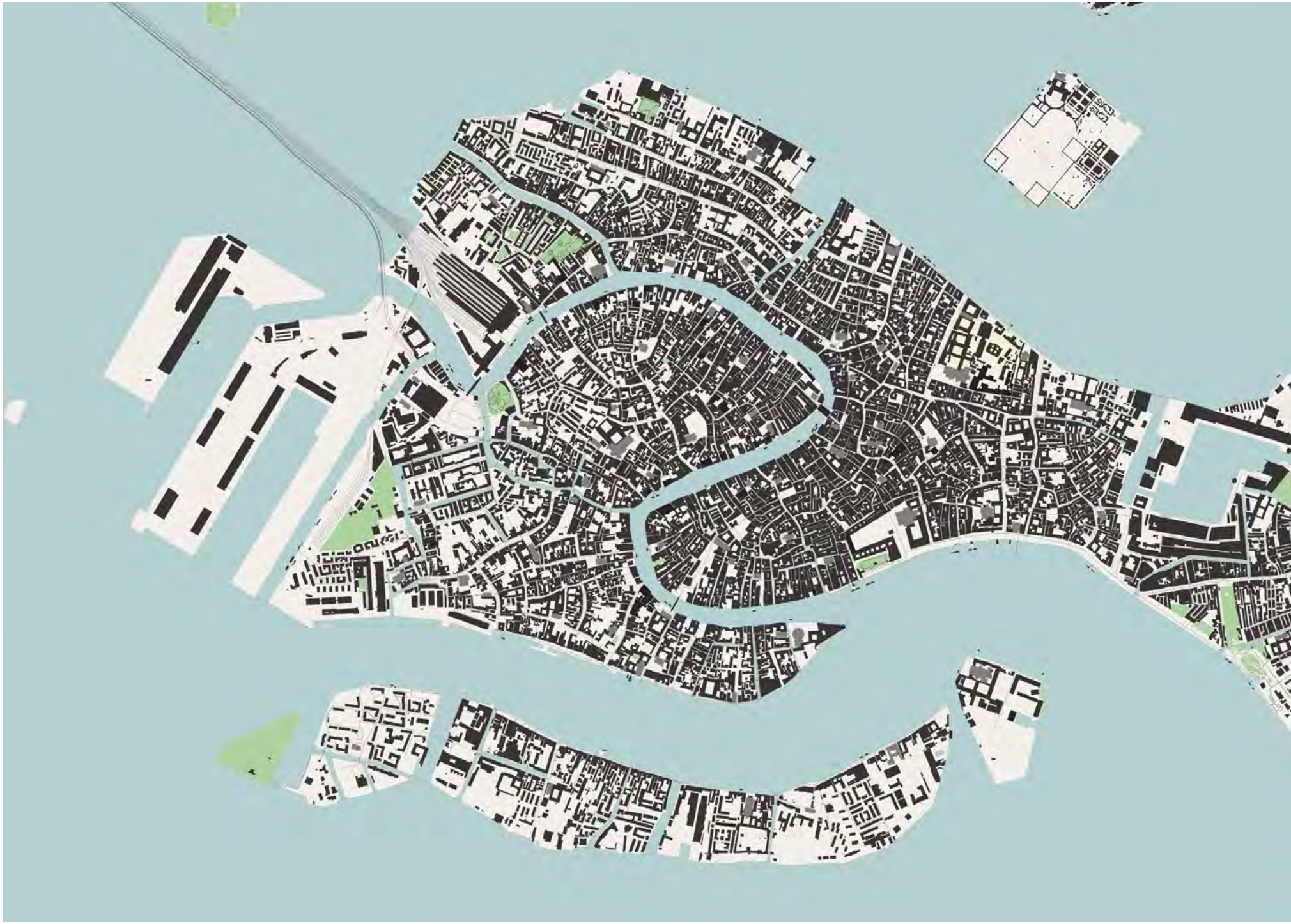
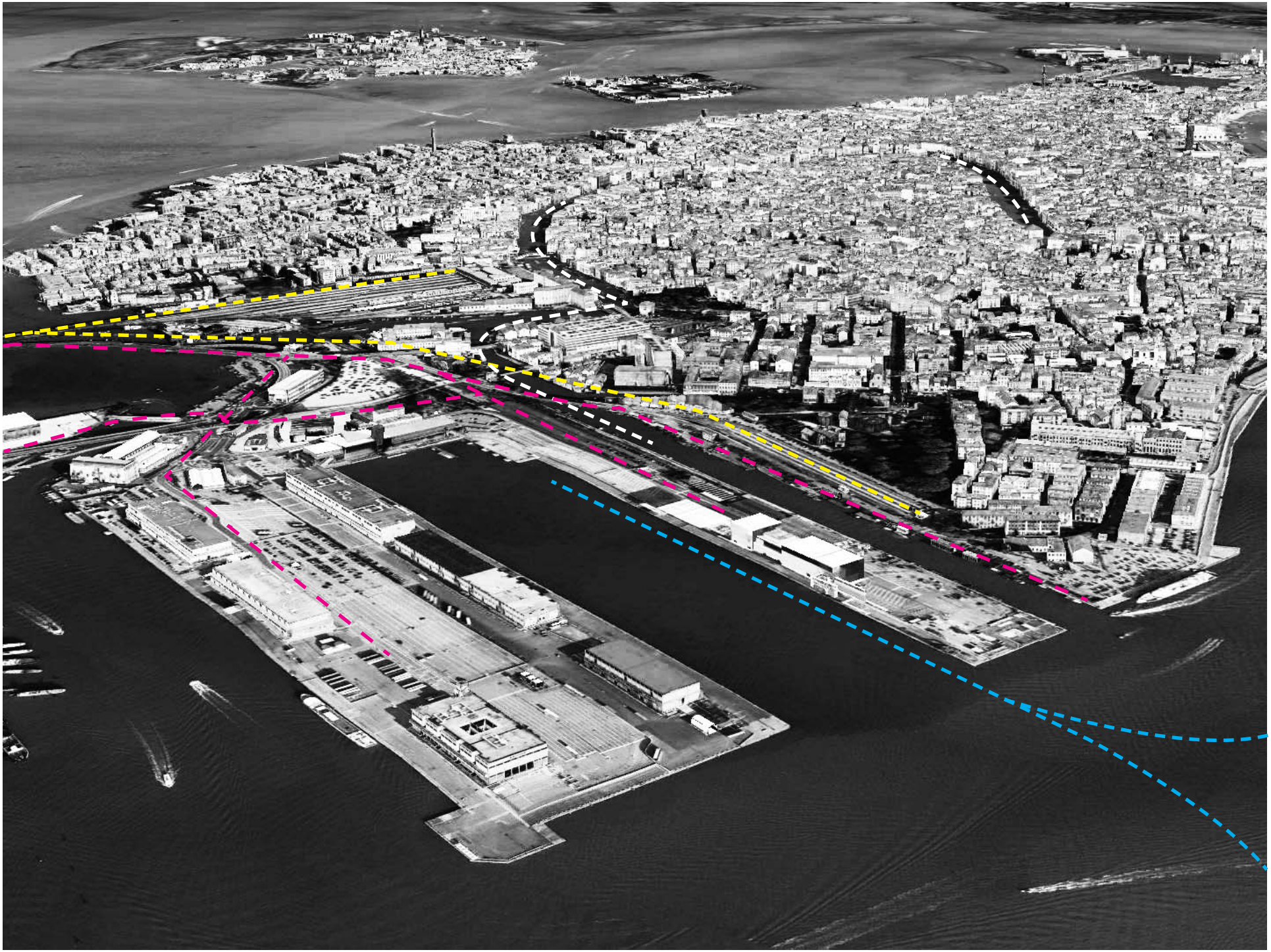
SOLSTICE



GREEN SPACES IN VENICE



SITE APPROACH AND TRANSPORTATION TYPES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MILLENNIUM


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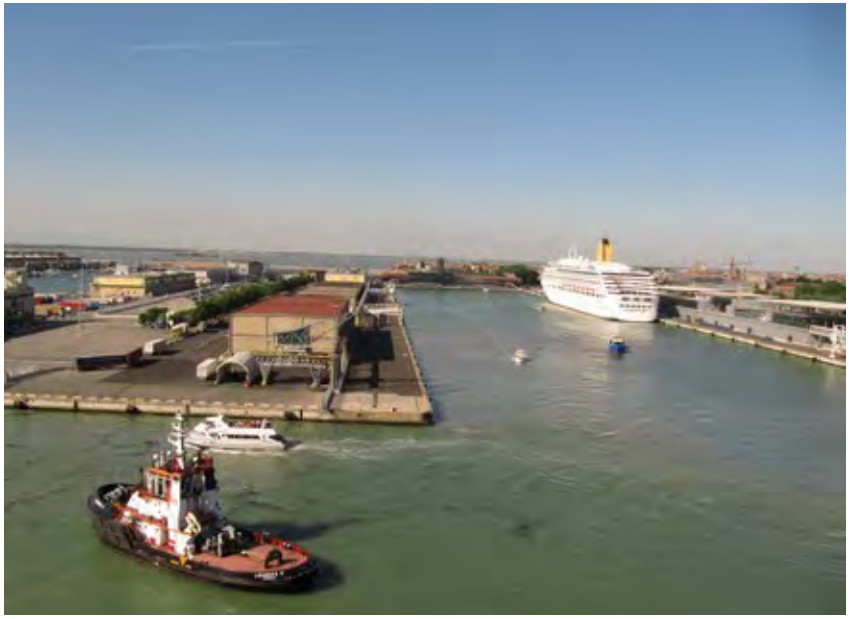
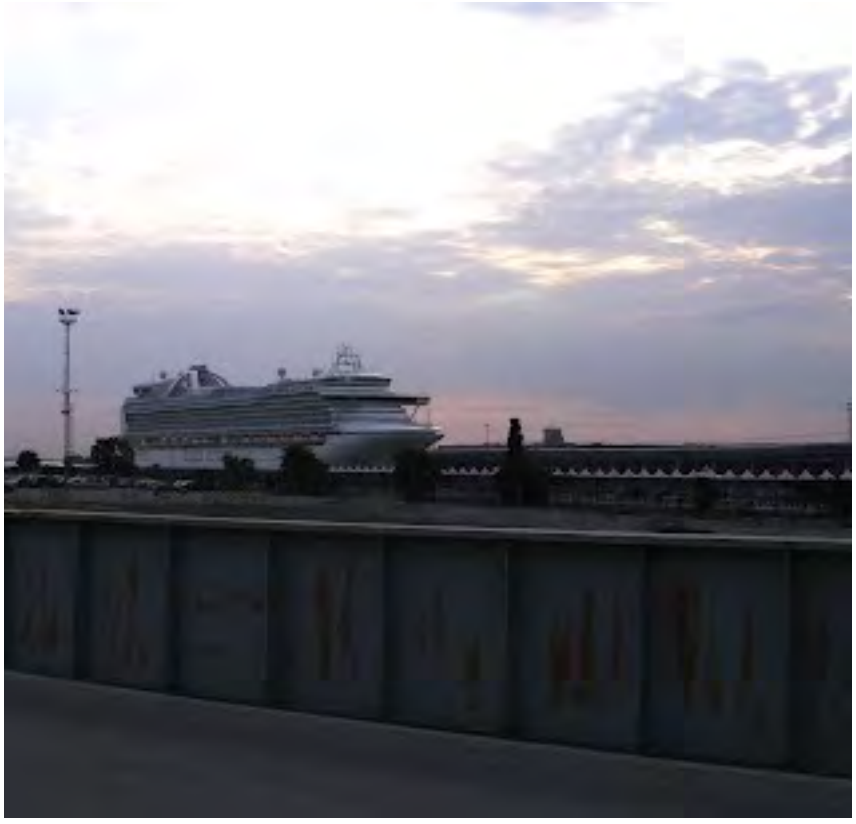
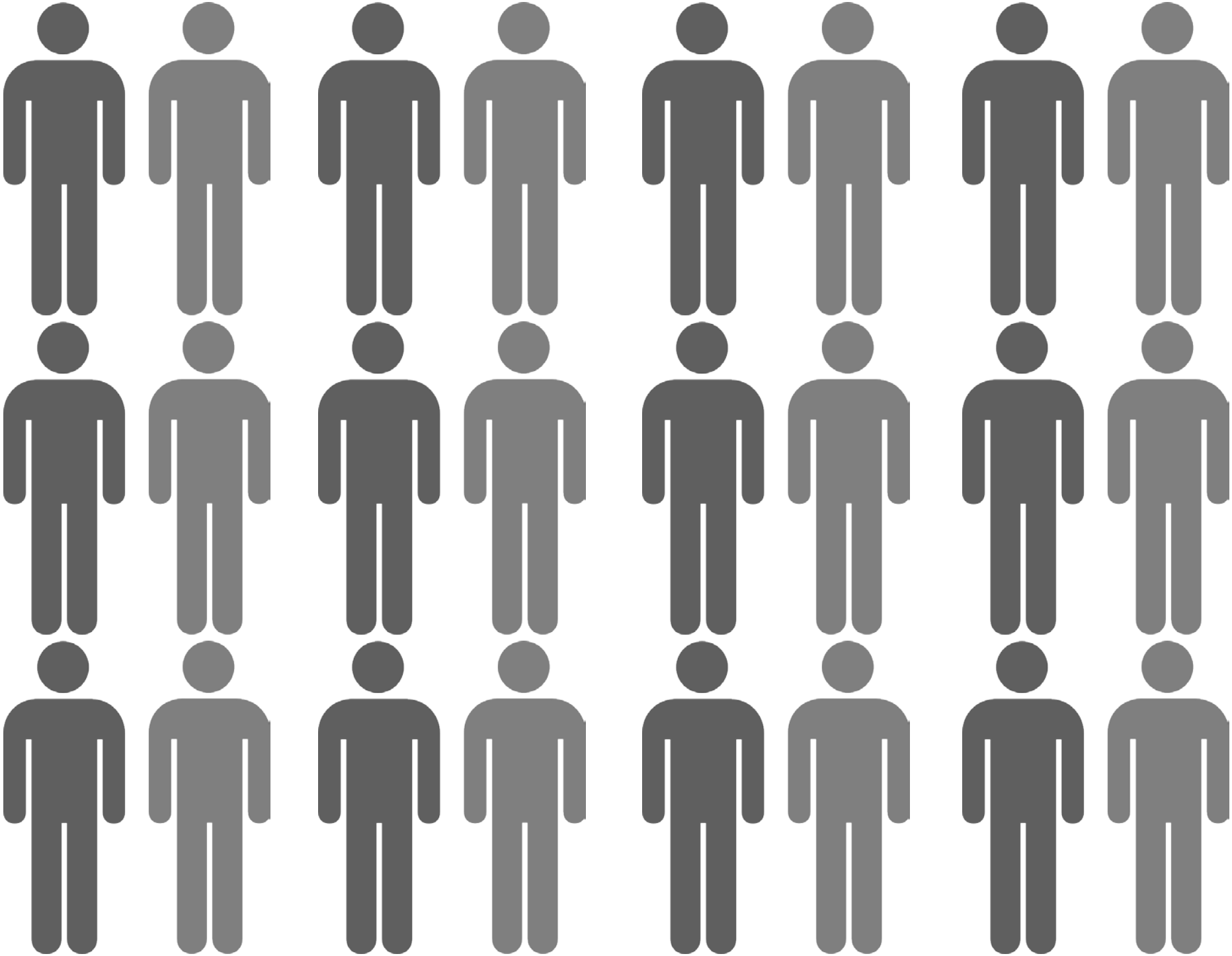
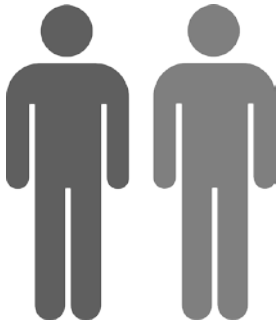
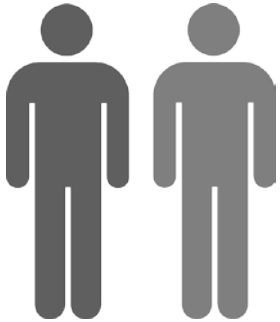




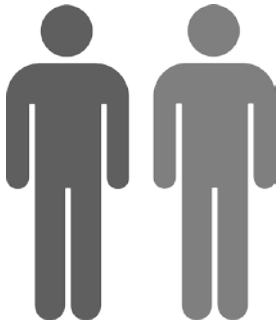




50,000 TOURISTS VISIT VENICE EVERY DAY.



2,000,000 TOURISTS VISIT VENICE ANNUALLY BY CRUISE SHIP.



12,000,000 TO 20,000,000 TOURISTS VISIT VENICE EVERY YEAR.

439%

INCREASE IN CRUISE DOCKINGS IN THE PAST 15 YEARS ACCORDING TO STATISTICS FROM THE VENICE PASSENGER TERMINAL.


Città d'Acqua

THE INTERNATIONAL CENTRE CITIES ON WATER IS CONCERNED WITH DOCUMENTATION, INFORMATION, STUDY AND RESEARCH INTO PROBLEMS AND EXPERIENCES OF URBAN SETTLEMENTS WHICH HAVE A CLOSE RELATIONSHIP WITH WATER. THE ASSOCIATIONS MAIN AIM IS TO ENCOURAGE AND IMPROVE SCIENTIFIC AND CULTURAL EXCHANGE BETWEEN CITIES ON WATER THROUGHOUT THE WORLD, AND TO ESTABLISH VENICE AS A REFERENCE POINT FOR ALL THOSE WHO ARE INVOLVED IN RESTORING A POSITIVE RELATIONSHIP BETWEEN WATER AND CITY, BETWEEN WATER AND URBAN CONTEXT. THE CENTRE CONCENTRATES ON THE MAIN ISSUES AFFECTING CITIES ON WATER THAT HAVE DEVELOPED ALONG COASTS, WITHIN GULFS, BAYS AND LAGOONS, WHICH ARE LOCATED ON LAKESIDES OR ESTUARIES OR ON THE BANKS OF IMPORTANT RIVERS.

CLIENT

A SBOCCHO IN A DAMAGED CANAL WALL

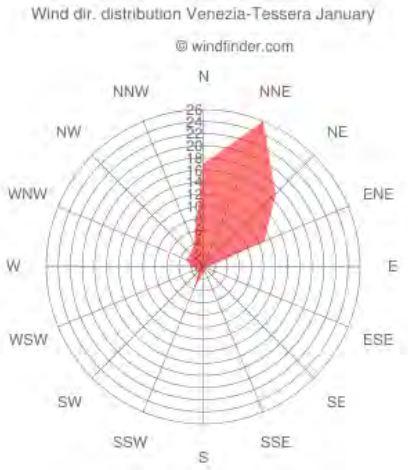
AN OUTLET OF A GATOLO IN VENICE

THE SEWAGE DISPOSAL SYSTEM WORKS THROUGH THE CANALS WITH NATURALLY OCCURRING TIDES. A CENTRAL SEWAGE TREATMENT PLANT WAS BUILT IN PORTO MARGHERA IN 1980S, BUT IS FAR FROM THE MAIN CENTER OF THE CITY OF VENICE. SEWAGE IS REMOVED AND TREATED THERE WHEN POSSIBLE, BUT SOME SEWAGE CONTINUES TO ENTER INTO THE CANALS. VENICE HAS SOME 140 SMALL BIOLOGICAL PLANTS THROUGHOUT THE CITY FOR WASTE TREATMENT, AND MORE THAN 6000 SEPTIC TANKS. PRIVATE RESIDENCES AND BUSINESSES SUCH AS HOTELS. HOWEVER, THE NUMBER OF PEOPLE, AMOUNT OF SEWAGE, AND OUTDATED SEWAGE DISPOSAL SYSTEMS HAVE CAUSED A VARIETY OF PROBLEMS IN VENICE.

CURRENT SEWAGE DISPOSAL

INSULA PROJECT

INSULA DREDGES VENICE'S CANALS TO GET RID OF THE DAMAGING SEDIMENTATION THAT HAS BUILT UP OVER THE YEARS, AND REPAIRS THE INFRASTRUCTURE THAT HAS BEEN DAMAGED BY SEDIMENT BUILDUP. INSULA REPAIRS CANAL WALLS AND SEWER OUTLETS THAT HAVE DETERIORATED OVER TIME, SEALING SEWER PIPES TO PREVENT TIDES FROM CAUSING DETERIORATION. INSULA HAS DONE ADAPTATIONS TO THE CURRENT SEWAGE DISPOSAL SYSTEM AS WELL, OPTIMIZING IT FOR BETTER FUNCTION THAT WILL BE EASIER TO MAINTAIN AND CAUSE LESS OF THE SEWAGE RELATED PROBLEMS PRESENT IN VENICE.


Wind dir. distribution Venezia-Tessera January
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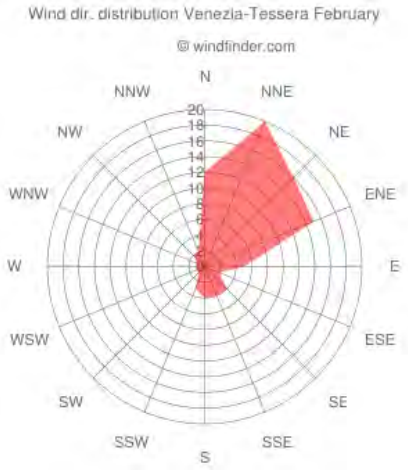
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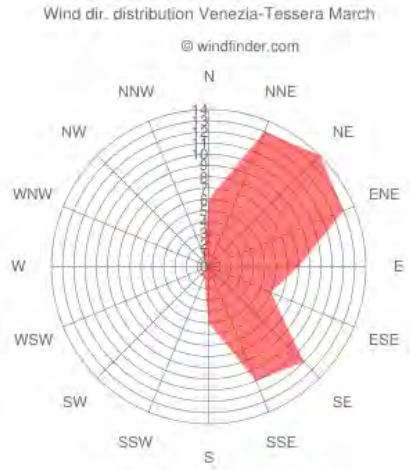
Wind dir. distribution Venezia-Tessera March
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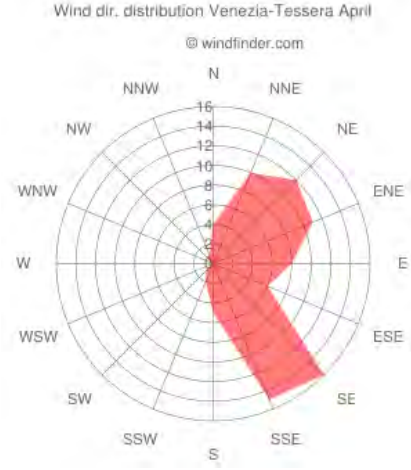
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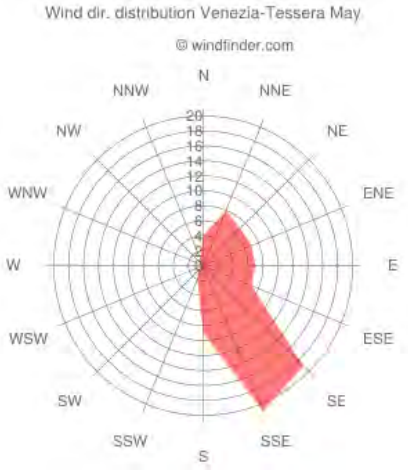
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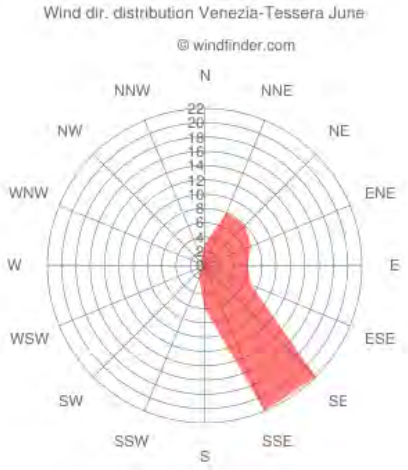
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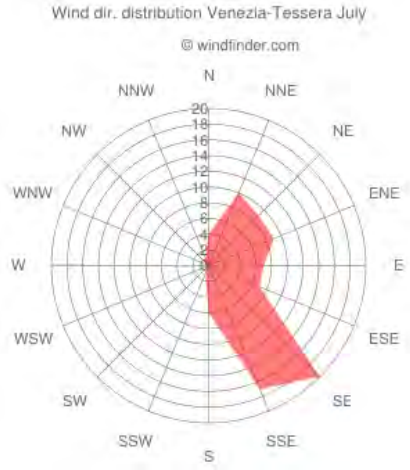
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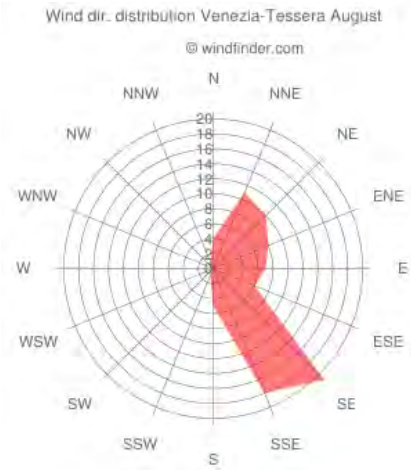
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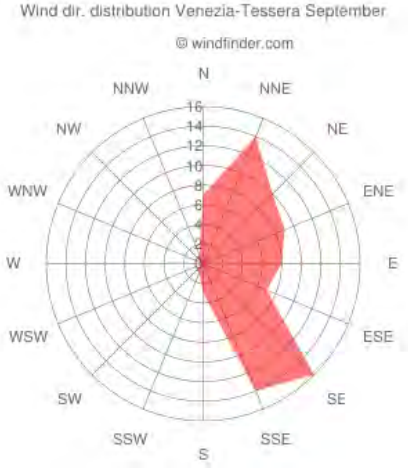
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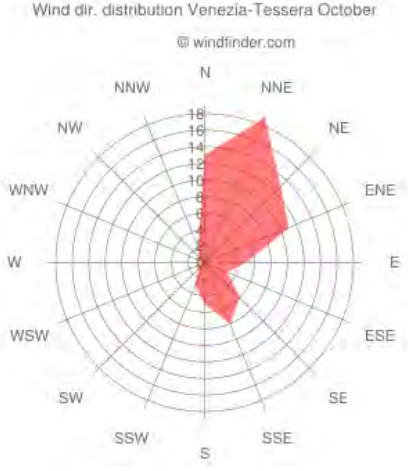
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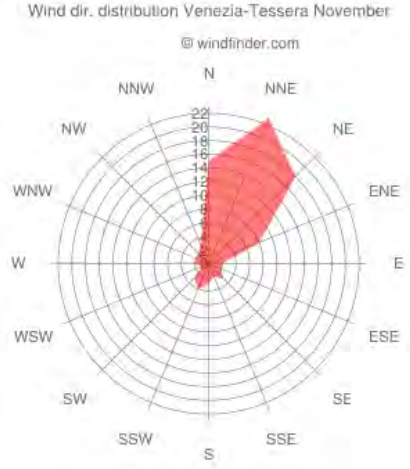
Wind dir. distribution Venezia-Tessera November
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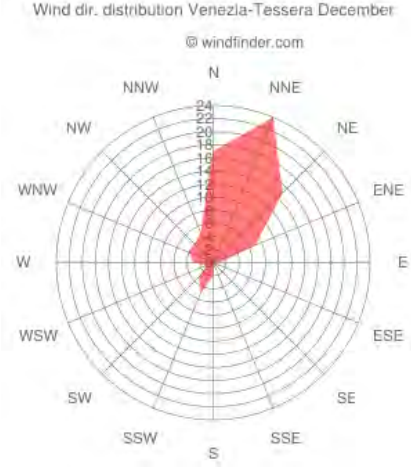
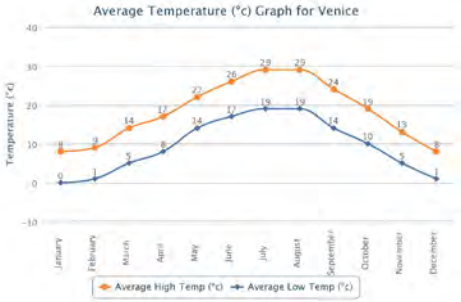
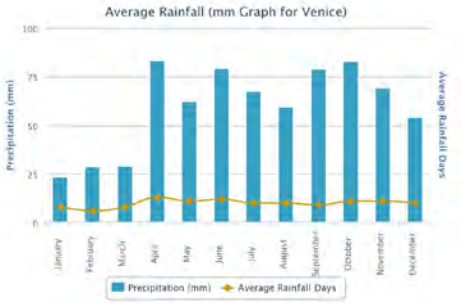

Wind dir. distribution Venezia-Tessera December
© windfinder.com
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW





THE CLIMATE IN VENICE IS CONSIDERED MILD WITH COMPARABLE CONDITIONS TO THE NORTHEAST OF THE UNITED STATES. GIVEN THIS CLIMATE TYPE AND THE NATURE OF THE PROJECT; PEOPLE WILL BE ABLE TO OCCUPY THE PUBLIC SECTORS OF THIS PROJECT YEAR ROUND.

SINCE THE PROJECT IS LOCATED ON A MAN MADE PENINSULA IN THE WESTERN AREA OF VENICE, THE RISING TIDES OF VENICE SHOULDN'T AFFECT THE ELEVATION OF THE STRUCTURE.

IN TERMS OF RAINFALL, VENICE HAS A LOW TO MODERATE AMOUNT OF RAINFALL YEARLY. WHILE THE PROJECT CELEBRATES GREEN SPACE AND THE OPENNESS OF THE PUBLIC REALM, 40% OF THE PROJECT'S PROGRAM IS COVERED HARDSCAPE AND IS OCCUPIED WITH RETAIL, THE RECYCLING CENTER AND PARKING.

ALTHOUGH THE PHYSICAL ENVIRONMENT OF VENICE IS SURROUNDED BY WATER, THE WIND IS ACTUALLY LIGHT TO MODERATE SEASONALLY. WITH MOST WIND COMING FROM THE NORTHEAST AT AN AVERAGE OF 12 MPH, THE SITE IS PROTECTED AND COMFORTABLE YEAR ROUND.

TYPICAL WEEK:
CRUISE SHIP WASTE GENERATION

50 TONS OF GARBAGE

2,000,000 GALLONS OF GREYWATER
35,000 GALLONS OIL-CONTAMINATED WATER

210,000 GALLONS OF SEWAGE

HEALTH RISKS

ONLY 70% OF WASTEWATER TREATMENT COVERAGE IN VENICE. THE 16TH CENTURY SEWAGE SYSTEMS, WHILE ONCE REVOLUTIONARY, IS INADEQUATE FOR A MODERN CITY. DIRECT DEPOSITING OF WASTES AND SEWAGE INTO THE CANALS IS UNSANITARY AND DANGEROUS. SEWAGE CONTAMINATES THE CANAL'S WATER WITH BACTERIA AND OTHER CONTAMINATES HAZARDOUS TO HUMANS. SIGNIFICANT LEVELS OF HEPATITIS A AND ENTEROVIRUSES HAVE BEEN DETECTED IN THE VENICE CANALS. THE SEASONAL FLOODING IN VENICE EXPOSES TOURISTS AND LOCALS TO THE DANGERS OF UNTREATED

STRUCTURAL RISKS

THE DATED SEWAGE DISPOSAL SYSTEM THREATENS THE STRUCTURAL INTEGRITY OF THE FOUNDATIONS AND CANAL WALLS THROUGHOUT THE CITY. THE BUILDUP OF SEDIMENT OVER TIME CAN CAUSE THE CANALS TO BECOME TO SHALLOW DURING LOW TIDES THAT THEY MAY BECOME IMPASSABLE. IF THE SEDIMENT BLOCKS THE SEWAGE OUTLETS OF THE BUILDINGS ADJACENT TO THE CANALS, THE OUTLETS CAN BURST AND CAUSE SEVERE DAMAGE. THE FOUNDATIONS OF THESE BUILDINGS BECOME FLOODED WITH SEA WATER AND SEDIMENT, WHICH DAMAGES NOT ONLY THE MASONRY AND MORTAR, BUT ALSO THE INFRASTRUCTURE SYSTEMS IN PLACE

TRANSPORTATION TERMINAL/// PARK SPACE

PARK

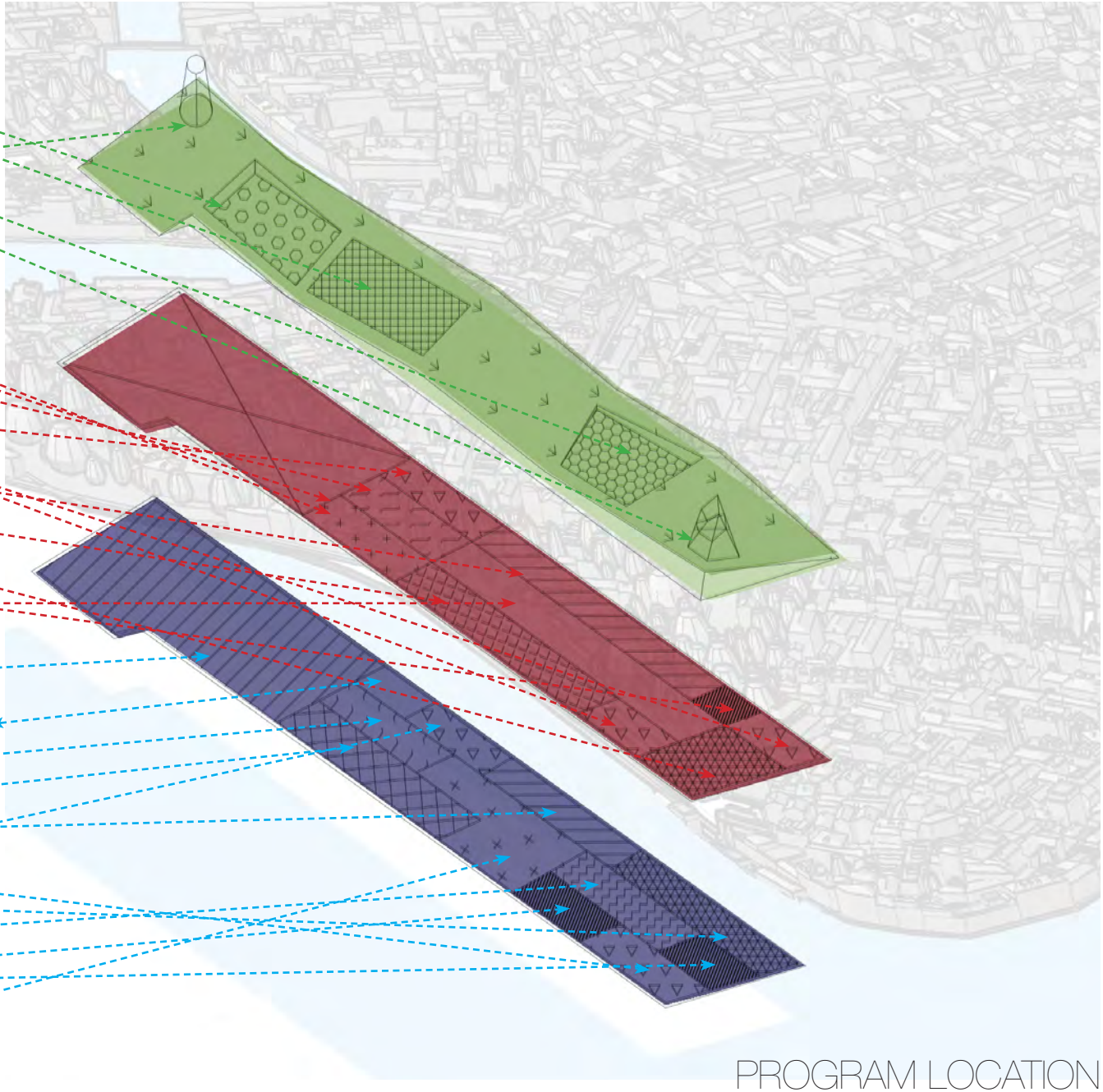
ATHLETIC FIELD
ATHLETIC SEATING
EVENT THEATRE
WIND FOLLY (CITY)
WATER FOLLY (LAGOON)

DEPARTURE

PARK ENTRANCE
GARAGE ENTRANCE
BAG CHECK/ STORAGE
RESTAURANT (3)
SHOPS
SEATING
EVENT HALL
BAR
SERVICES/ FACILITIES

ARRIVAL

GARAGE
WATER TAXI PICKUP/ DROPOFF
BAG CHECK/ STORAGE
SERVICES/ FACILITIES
SHOPS
RESTAURANTS (2)
CONFERENCE HALL/ OFFICES
GALLERY
BAR (2)
WASTE MANAGEMENT/
RECYCLING CENTER



PROGRAM LOCATION

TRANSPORTATION TERMINAL/// PARK SPACE

PARK (800,000 SF)
ATHLETIC FIELD
ATHLETIC SEATING
EVENT THEATRE
WIND FOLLY (CITY)
WATER FOLLY (LAGOON)

DEPARTURE (227,000 SF)
PARK ENTRANCE
GARAGE ENTRANCE
BAG CHECK/ STORAGE 10,000 SF
RESTAURANT (3) 6000 SF @ 2000 SF EACH
SHOPS 5000 SF
SEATING 200,000 SF
EVENT HALL 5000 SF
BAR 1000 SF

SERVICES/ FACILITIES 45,400 SF

ARRIVAL (443,500 SF)
GARAGE 300,000 SF
WATER TAXI PICKUP/ DROPOFF 2000 SF
BAG CHECK/ STORAGE 10,000 SF
SERVICES/ FACILITIES 76,700 SF
SHOPS 8000 SF
RESTAURANTS (2) 4000 SF
CONFERENCE HALL/ OFFICES 7500 SF
GALLERY 30,000 SF
BAR (2) 2000 SF
WASTE MANAGEMENT/ 100,000 SF
RECYCLING CENTER

PROGRAM BREAKDOWN

4.

FOLLY FOR PURPOSE

transpor-
tation
terminal
under
built-up
topogra-
phy

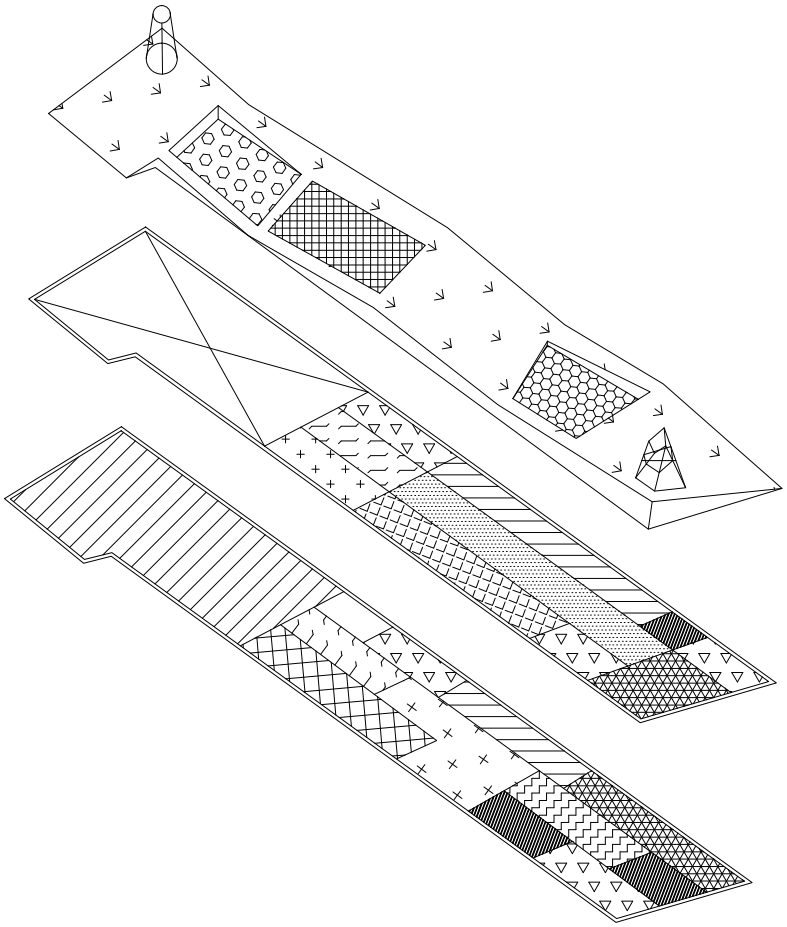
park space over terminal/parking/services_follies ar
cluded at the opposite points of the built park

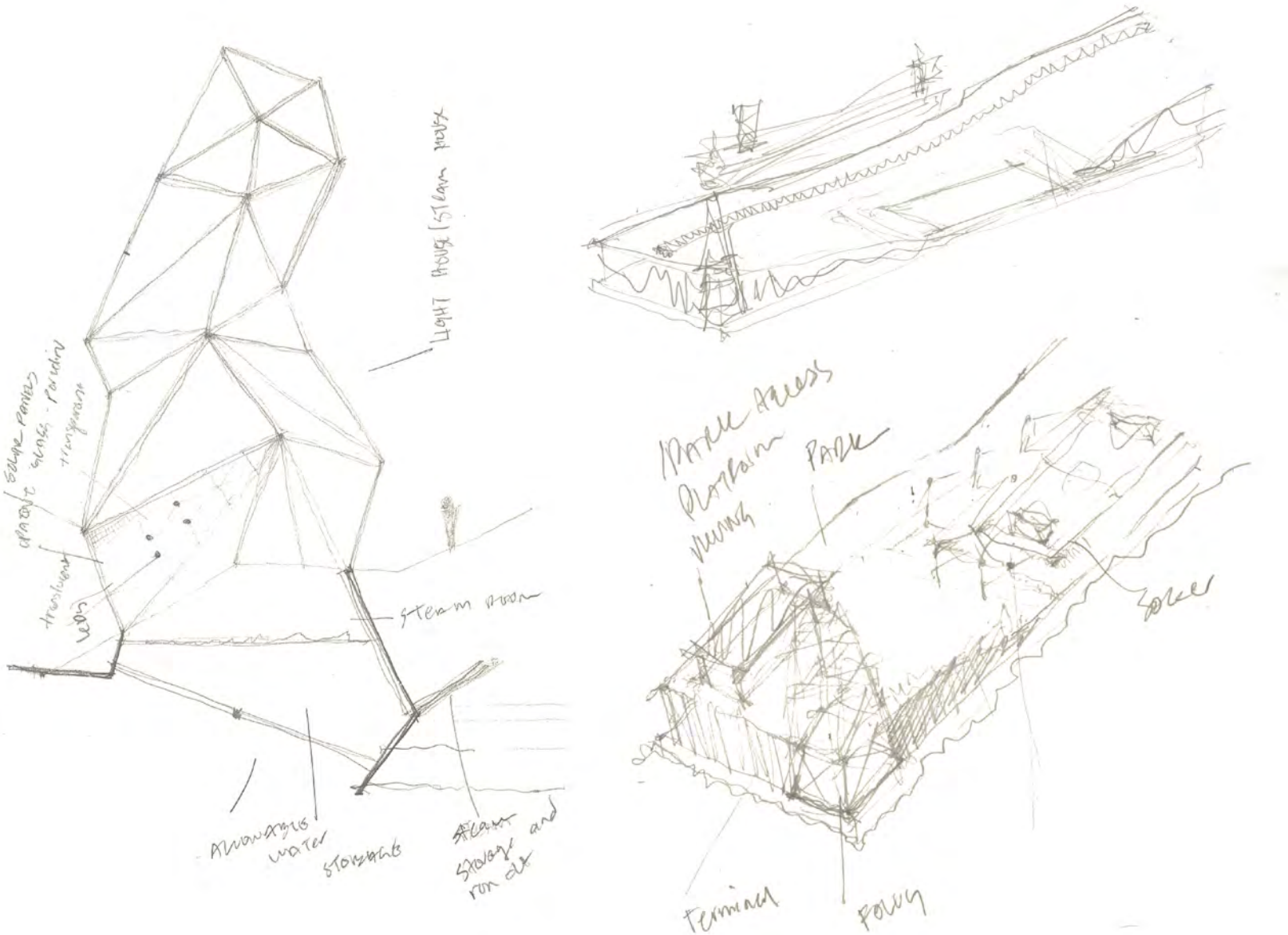
parking
area and
services
under
built-up
topogra-
phy

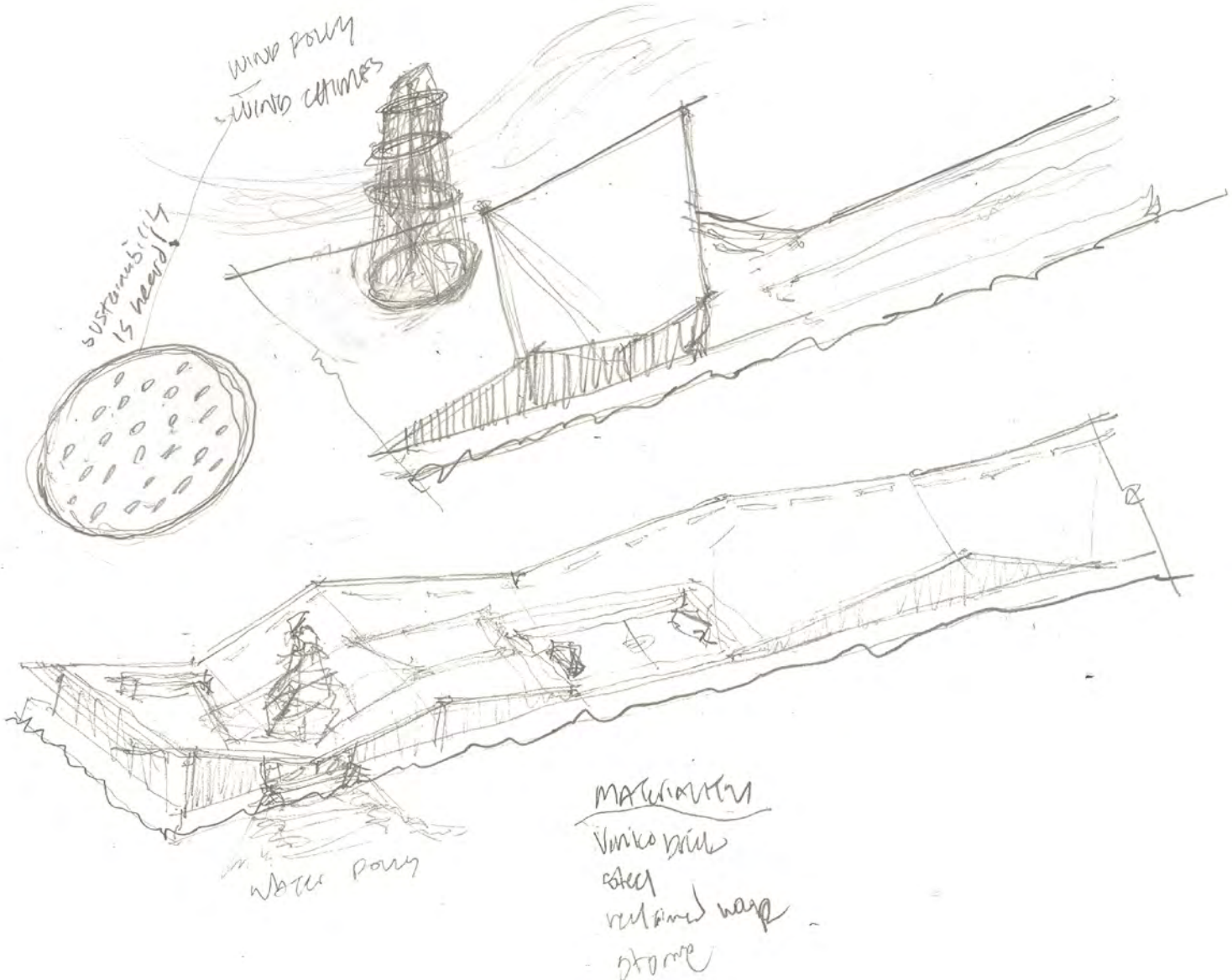
re in-

WHAT IS A FOLLY? THEY HAVE NO PURPOSE OTHER THAN AS AN ORNAMENT. THEY ARE BUILDINGS, OR PARTS OF BUILDINGS. THEY ARE PURPOSE-BUILT. THEY ARE OFTEN ECCENTRIC IN DESIGN OR CONSTRUCTION. THERE IS OFTEN AN ELEMENT OF FAKERY IN THEIR CONSTRUCTION. THEY WERE BUILT OR COMMISSIONED FOR PLEASURE.

A FOLLY COULD BE ANYTHING, OR IT COULD BE NOTHING. I THINK IT SHOULD BE SOMETHING. I WANT TO DESIGN A FOLLY THAT REACHES FURTHER THAN ITS NAME. WHAT IS A FOLLY? OR WHAT COULD IT BE? IT COULD BE A BEACON FOR SUSTAINABILITY. IT WILL BE A BEACON FOR SUSTAINABILITY, COMMUNICATING ITS VERY PURPOSE THROUGH SMART DESIGN AND PURPOSEFUL DECISIONS WHICH WILL ULTIMATELY EDUCATE THOSE WHO EXPERIENCE IT. AND I THINK THIS FOLLY WILL BEST COMMUNICATE ITS PURPOSE INSIDE A PARK. SO A FOLLY [FOR PURPOSE], DESIGNED TO UTILIZE THE ELEMENTS, AND COMMUNICATE IT'S STRATEGIES [IN MOTION],




LIGHT AROUND [STEAM ROOM
SOLAR PANELS
TRANSLUCENT
STEAM ROOM
PARK
TERMINAL
POWER



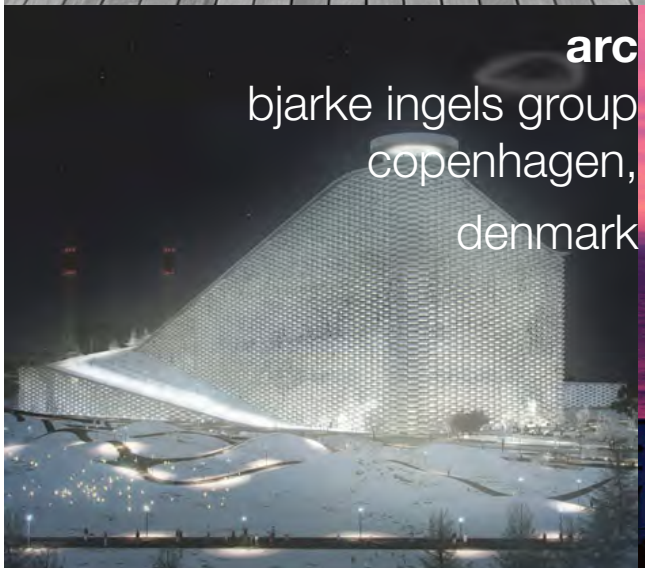
FOLLY SKETCHES

5.

CONCEPTUAL FRAMEWORK

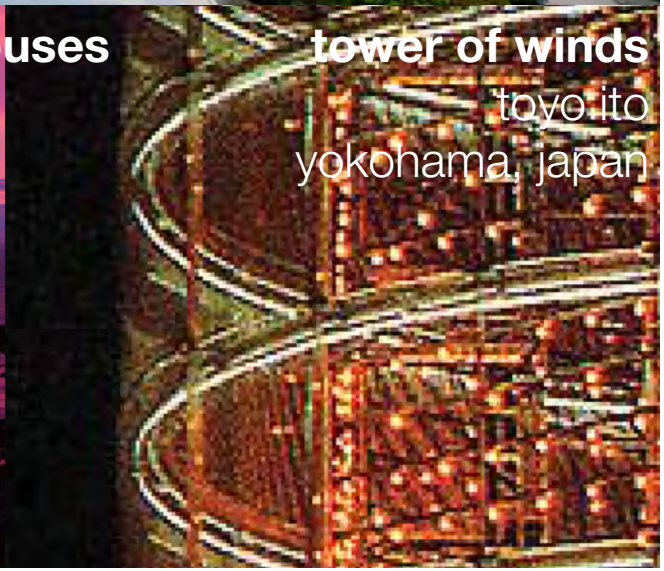
yokohama port terminal
foreign office architects
tokyo, japan

(ctrv) waste treatment facility
Batlle & Roig architects
VACARISSES, BARCELONA



arc
bjarke ingels group
copenhagen,
denmark

lighthouses



tower of winds
toyo ito
yokohama, japan

EACH PRECEDENT WAS SELECTED FOR THEIR SIMILAR ATTRIBUTES AND PROGRAM. THE YOKOHAMA PORT TERMINAL WAS SELECTED SINCE IT MOST CLOSELY RELATES TO THE PROJECT TYPE, THE PROGRAM AND PEOPLE BEING SERVED BY THE SPACE. THE DEVELOPMENT AND FORMATION OF HARDSCAPE WAS A DRIVING FORCE FOR MOVEMENT AND LEISURE. THE VENICE SITE IS VERY SIMILAR PROGRAMMATICALLY AND THIS PROJECT WAS HELPFUL IN THE UNDERSTANDING OF HARDSCAPE, FORM AND SCALE. THE NEXT PROJECT, THE CRTV WASTE TREATMENT FACILITY - WAS CHOSEN TO UNDERSTAND HOW TO CREATE A BEAUTIFUL SPACE THAT SERVES A DIRTY PROGRAM. A MAJOR PART OF THIS PROJECT IS RECYCLING THE WASTES FROM CRUISE SHIPS AND WATER POLLUTION, THE DESIGN OF THE TREATMENT FACILITY IN BARCELONA GAVE ME THE INSPIRATION TO CREATE A BEAUTIFUL SPACE THAT SERVES AN IMPORTANT FUNCTION. ALSO SIMILAR, THE ARC PROJECT BY BIG ARCHITECTS SERVES AS AN EXEMPLARY EXAMPLE OF HOW A PARK, A FOLLY AND A WASTE TREATMENT CAN WORK TOGETHER SIMULTANEOUSLY. THE IDEA OF THE LIGHTHOUSE DRIVES THE BIG PROJECT AS IT DOES THE VENICE ONE. THE MAIN STRUCTURE ACTS AS A BEACON, NOT AS A WARNING, BUT AS AN INDICATOR OF CHANGE AND PROGRESS. THE FOLLIES ON THE VENICE SITE ACT AS EDUCATIONAL INDICATORS AND TECHNOLOGICAL ADVANCEMENTS. LASTLY, SIMILARLY TO BIG'S ARC; TOYO ITO'S TOWER OF WINDS DRESSED WATER TANKS AND CONDITIONING EQUIPMENT WITH GLOWING RINGS AND A SYMPHONY OF LIGHT - WELCOMING VISITORS AND CITY DWELLERS. THIS PROJECT INCORPORATES THE IDEAS OF THESE PROJECTS AS ODES TO THEIR INDIVIDUAL BRILLIANCE.

I.

CONCEPTUAL FRAMEWORK

EARLY WORK

thesis statement:

Sustainability *is* the future of architecture; however, sustainable options frequently act as appendages in the design process. Architectural design and sustainability *should* work in tandem; and thus communicate their purpose in real time. This project explores a creative outlook on sustainable architecture while also extending the education and understanding of sustainable elements in motion.

possible client:

Città d'Acqua

The International Centre Cities on Water is concerned with documentation, information, study and research into the problems and experiences of urban settlements which have a close relationship with water.

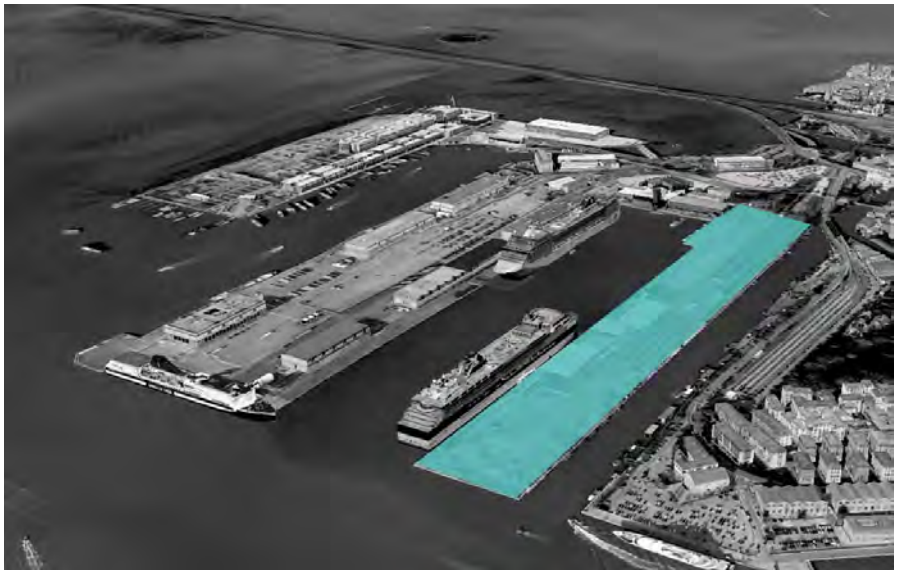
The association's main aim is to encourage and improve scientific and cultural exchange between cities on water throughout the world, and to establish Venice as a reference point for all those who are involved in restoring a positive relationship between water and city, between water and urban context.

The Centre concentrates on the main issues affecting cities on water that have developed along coasts, within gulfs, bays and lagoons, which are located on lakesides or estuaries or on the banks of important rivers.

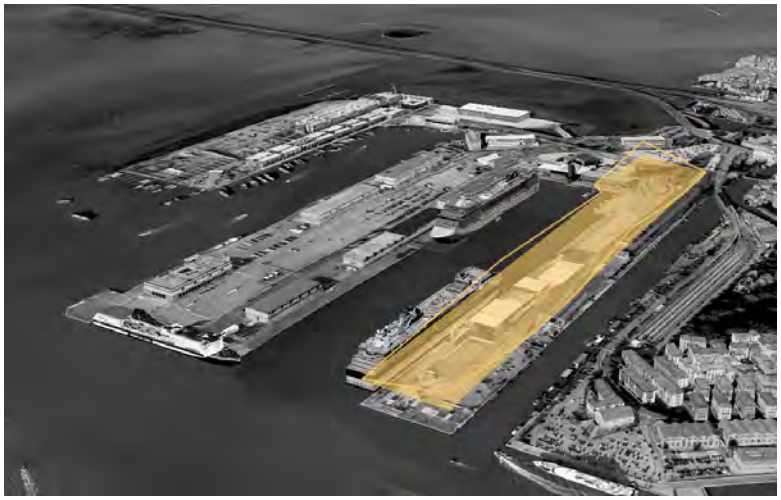
possible site:

Tronchetto is an artificial island in the Venetian Lagoon, northern Italy, located at the westernmost tip of the main Venice island. The island was created in the 1960s, **and now is used as a car park for tourists who cannot bring their vehicles into the city**. The Venice People Mover connects Tronchetto with Piazzale Roma, the main Venice bus station, which lies at the edge of the city center.

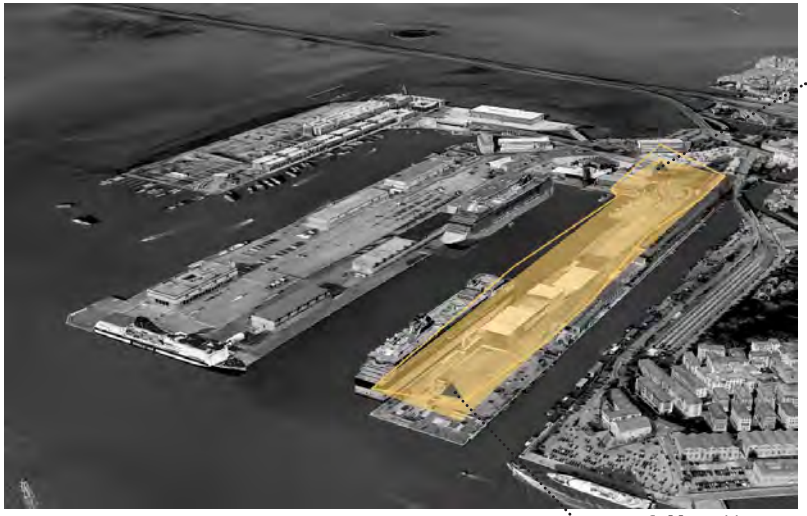
current topography:



future topography:



folly locations



wind folly addresses the entrance to the city

water folly addresses the shipping and transportation lanes

possible program

transpor-tation terminal under built-up topogra-phy

parking area and services under built-up topogra-phy

park space over terminal/parking/services_follies are in-cluded at the opposite points of the built park

moving forward:

while the purpose of the follies would ultimately aim to communicate successful , sustainable architectural design ; in its' own respect_these follies would also power the program outlined thus far. program working with site, working with design, working with sustainability, working to communicate and ***finally*** educate is the purpose of this project.

site analysis: in brief

in general:

Venice, a city in the north eastern part of Italy, is unique because it is actually situated on 118 individual islands. Venice is known for its canals, the setting, the architecture and the arts. About 270,000 people reside here. Venice is about 160 square miles in area, and only 1 meter above sea level.

construction:

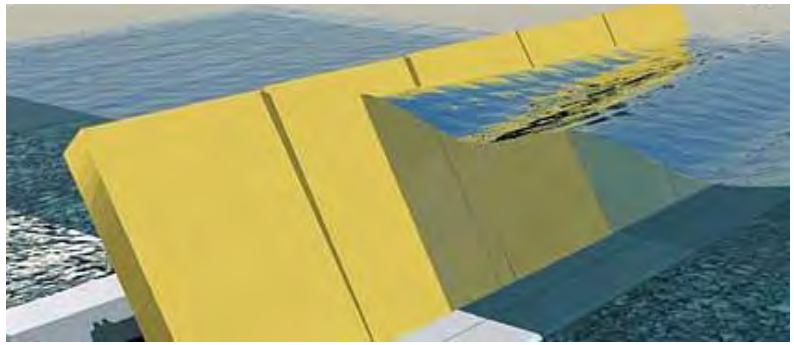
the buildings in venice are constructed on wood-
en piles, the foundations rest on these piles. the
vernacular style of brick or stone sit on these
footings.

f l o o d i n g :

Venice is threatened by flood tides pushing in from the Adriatic Sea between Fall and Spring. artesian wells were sunk into the lagoon to draw water; however, this caused venice to sink, and allow low level flooding into the ground floor of the city. Since the 60s when the wells were banned, some studies show that the city is no longer sinking.

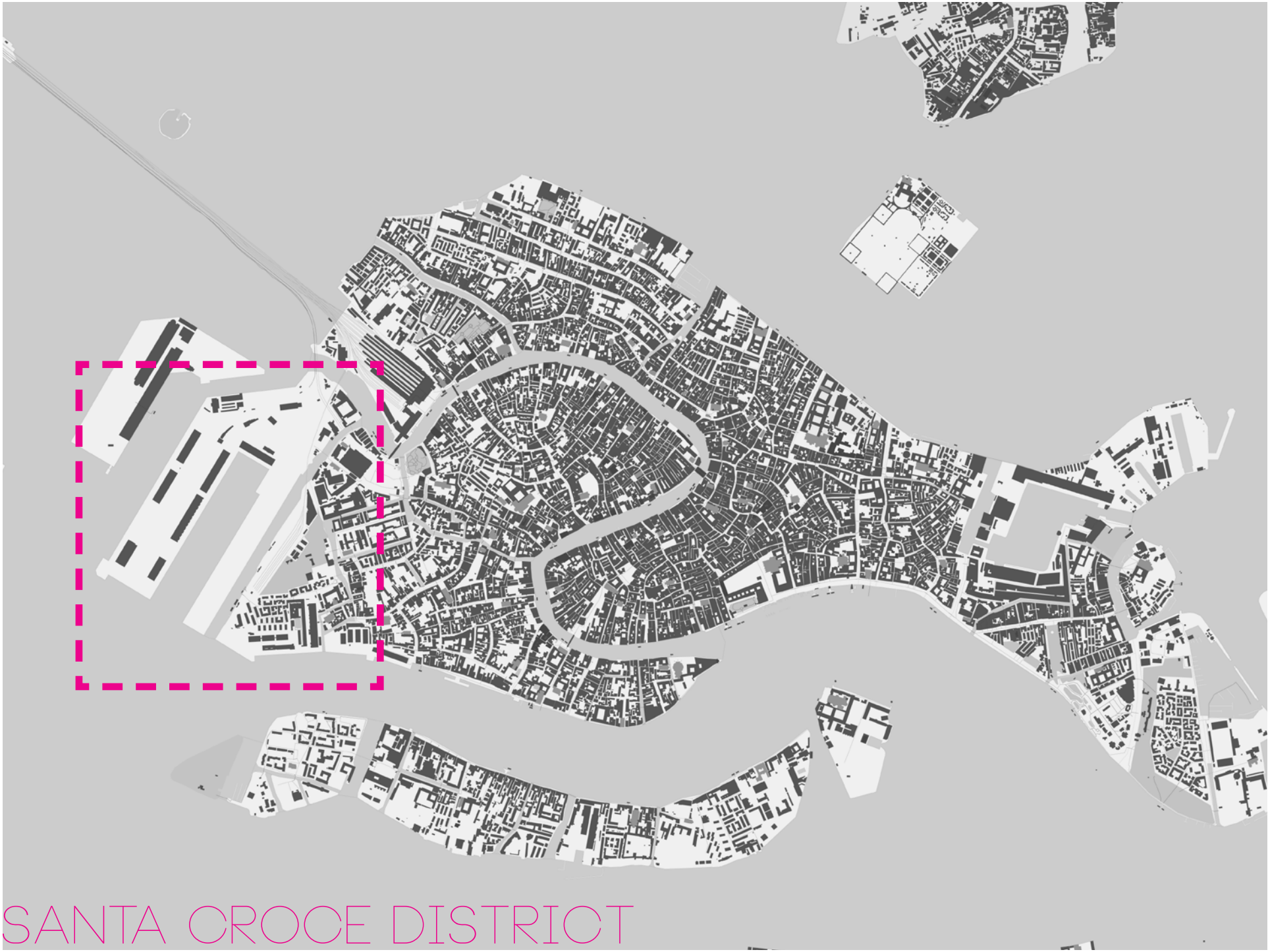
p r e v e n t i o n :

In 2003, Italian Prime Minister Silvio Berlusconi inagurated the MOSE Project [Modulo Sperimentale Elettromeccanico], an experimental model for evaluating the performance of hollow floatable gates. The idea is to fix a series of floatable pontoons to the sea bed, when tides are predicted to exceed 110 centimeters, the pontoons will fill with air, causing them to float and block incoming water.

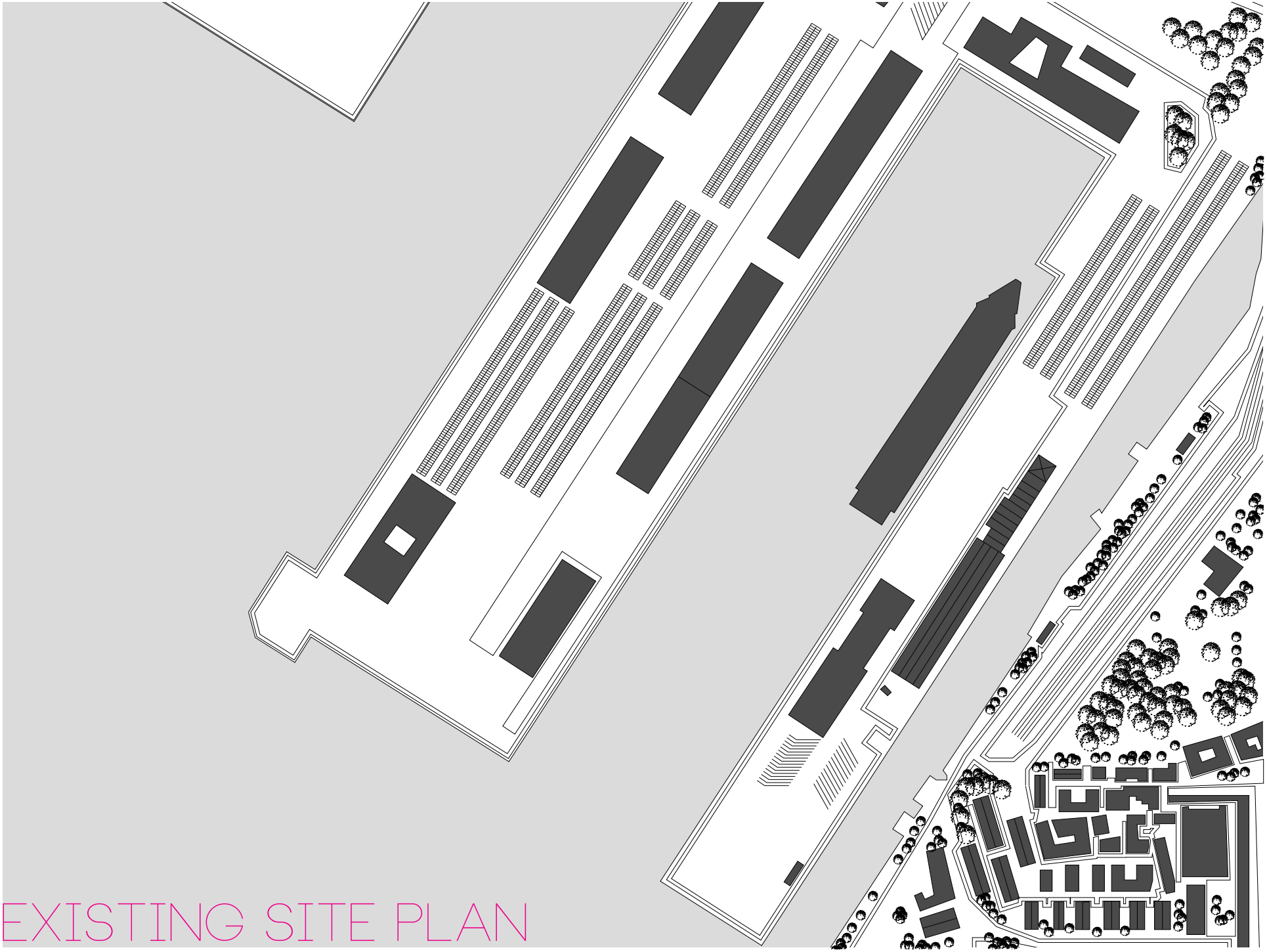


recent news:

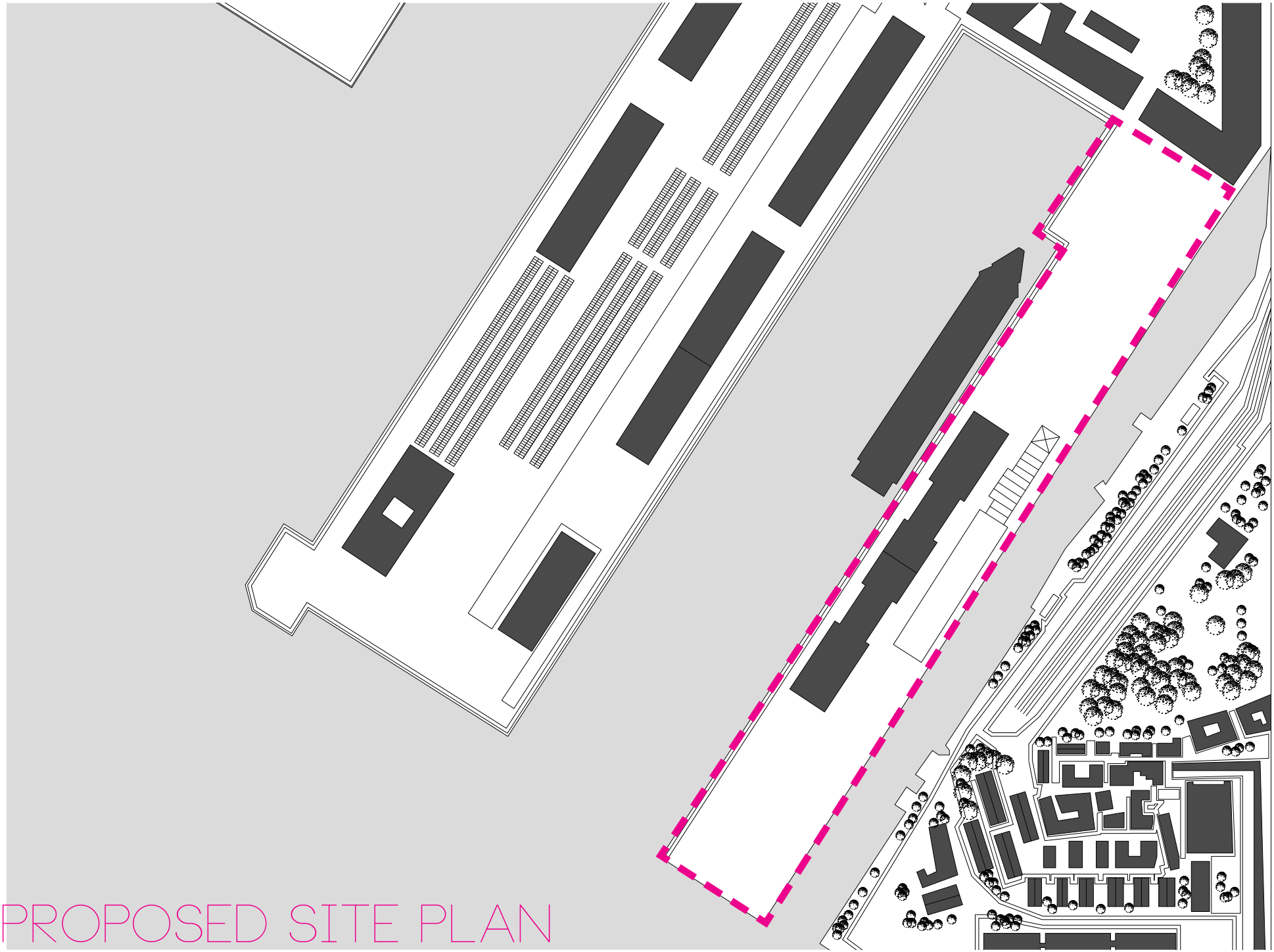
while the MOSE project is set to finish in 2014, Italy will immediately begin to limit the amount of large cruise ship traffic in the Venice lagoon. protests by residents and environmentalists have increased with the knowledge that these ships are harming the fragile city. So far the plan is to limit/shut down cruise ship traffic in parts of the venice lagoon. The mayor of Venice reported that these cruise ships have been meters away from San Marco, in order to prevent future damage, there will be clear limits on the size of the ships entering the lagoon.



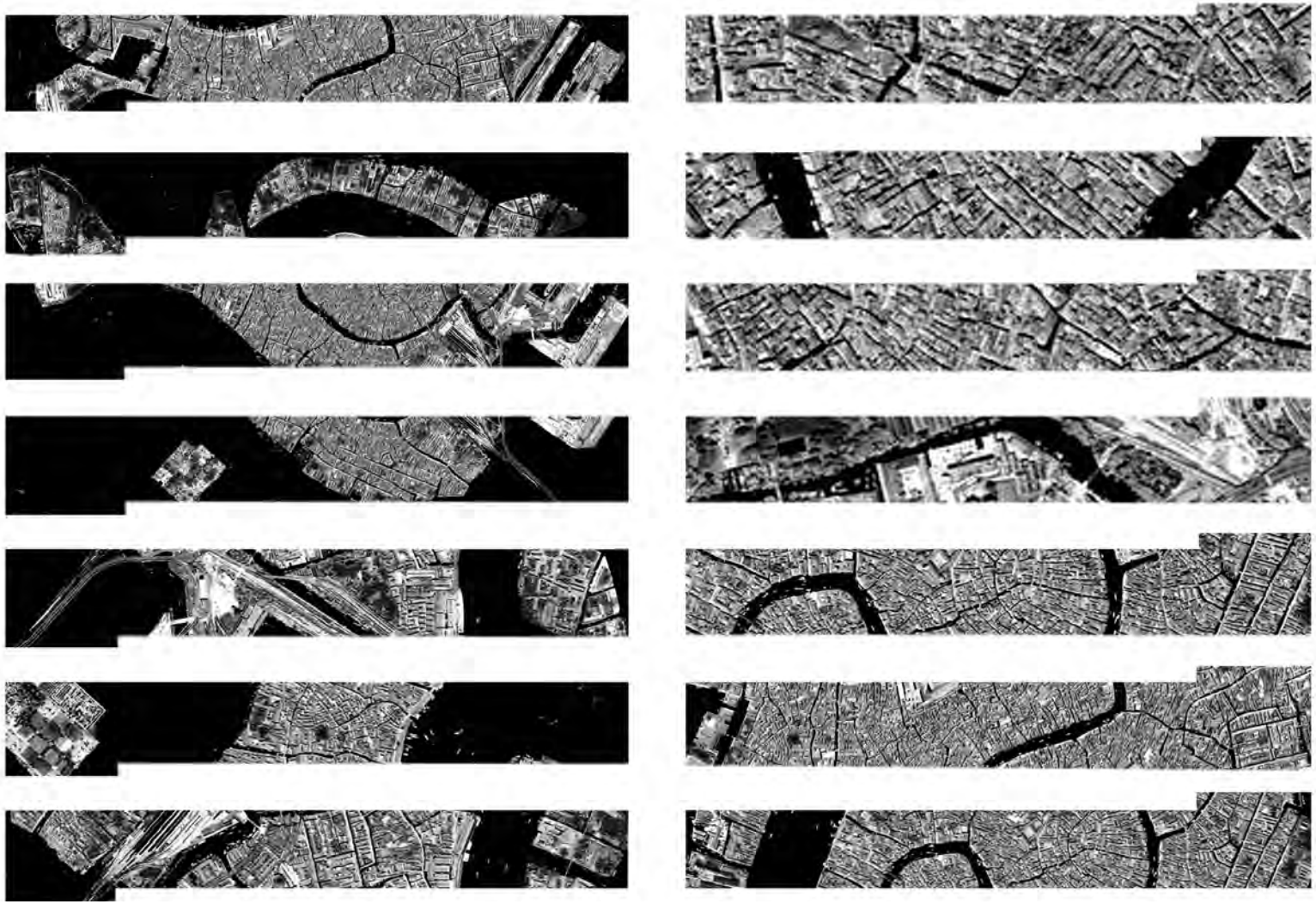
SANTA CROCE DISTRICT



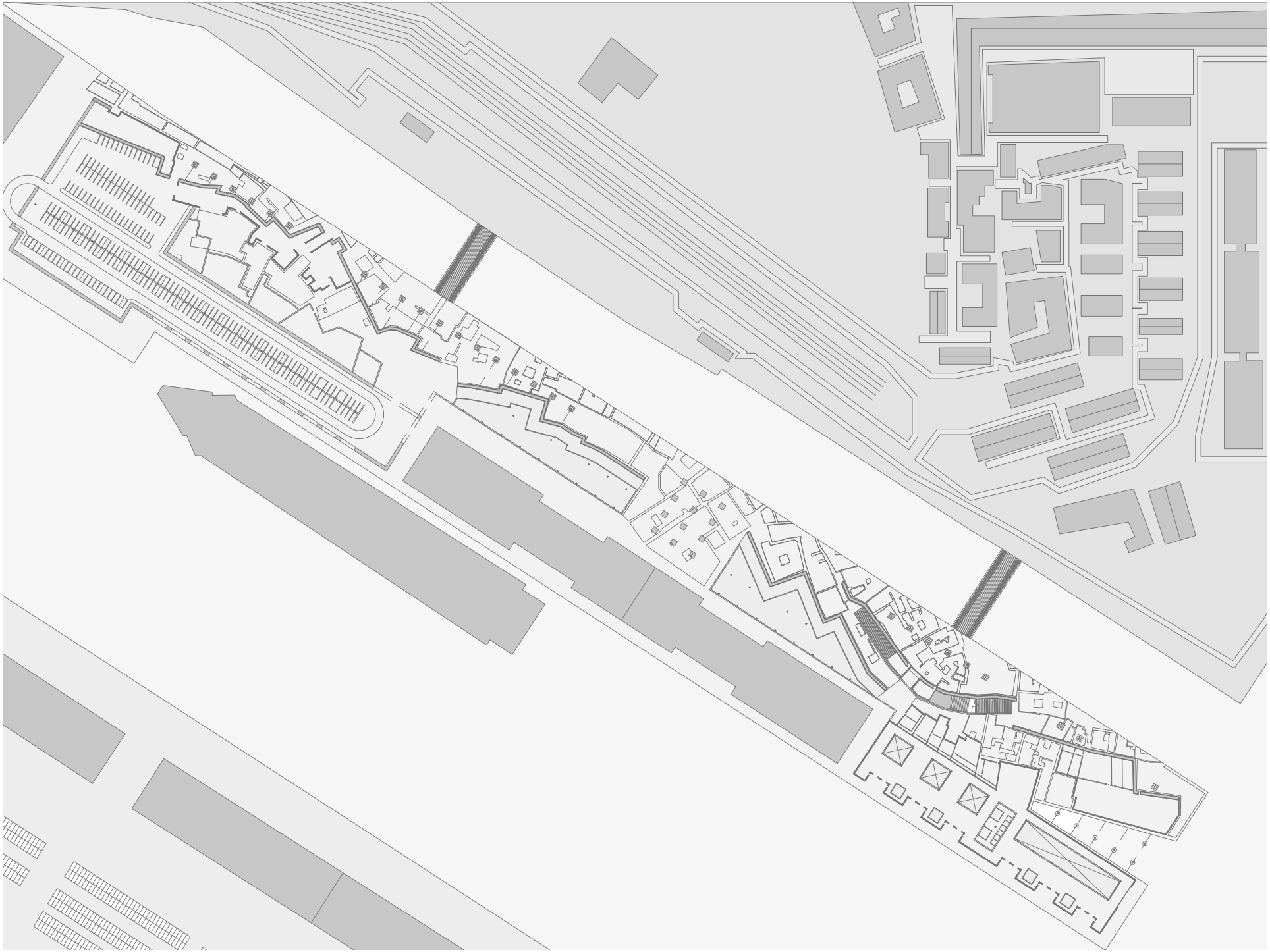
EXISTING SITE PLAN

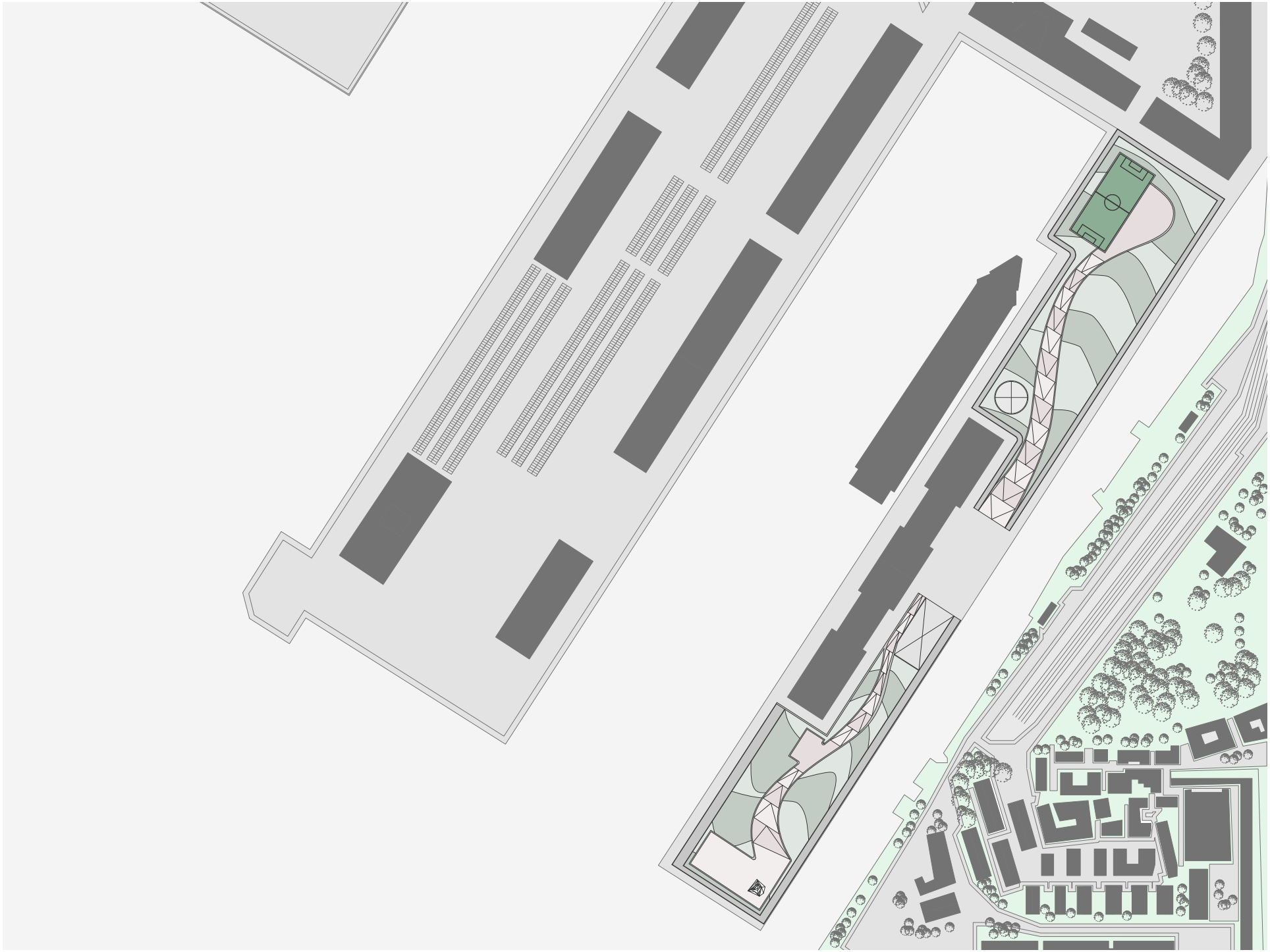


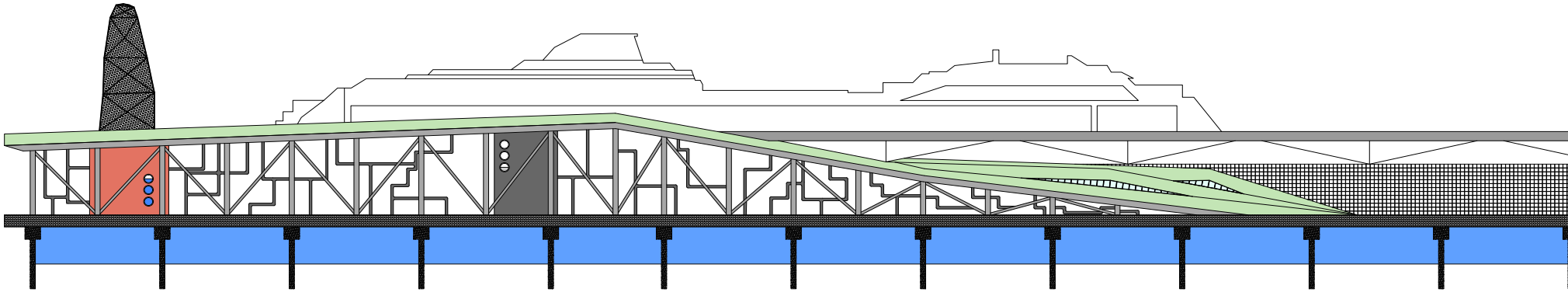
PROPOSED SITE PLAN



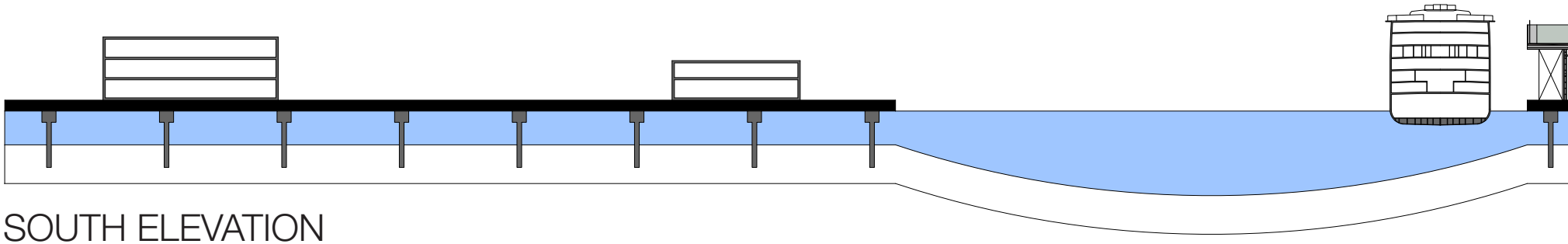
INITIALLY, MY APPROACH TO LAYING OUT THE SITE WAS TO OVERLAY THE PERIMETER OF MY SITE OVER DIFFERENT MAGNIFICATIONS OF VENICE, THIS APPROACH MADE WAY FOR MANY DIFFERENT ITERATIONS OF SITE DESIGN BOTH INTERNALLY AND EXTERNALLY.



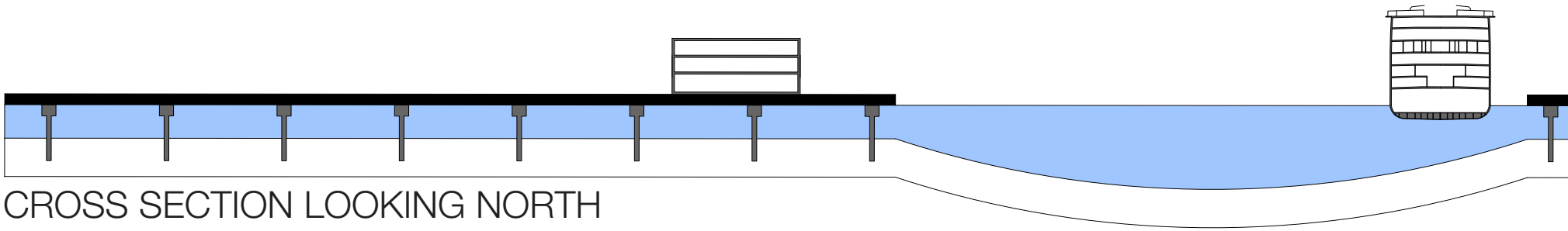




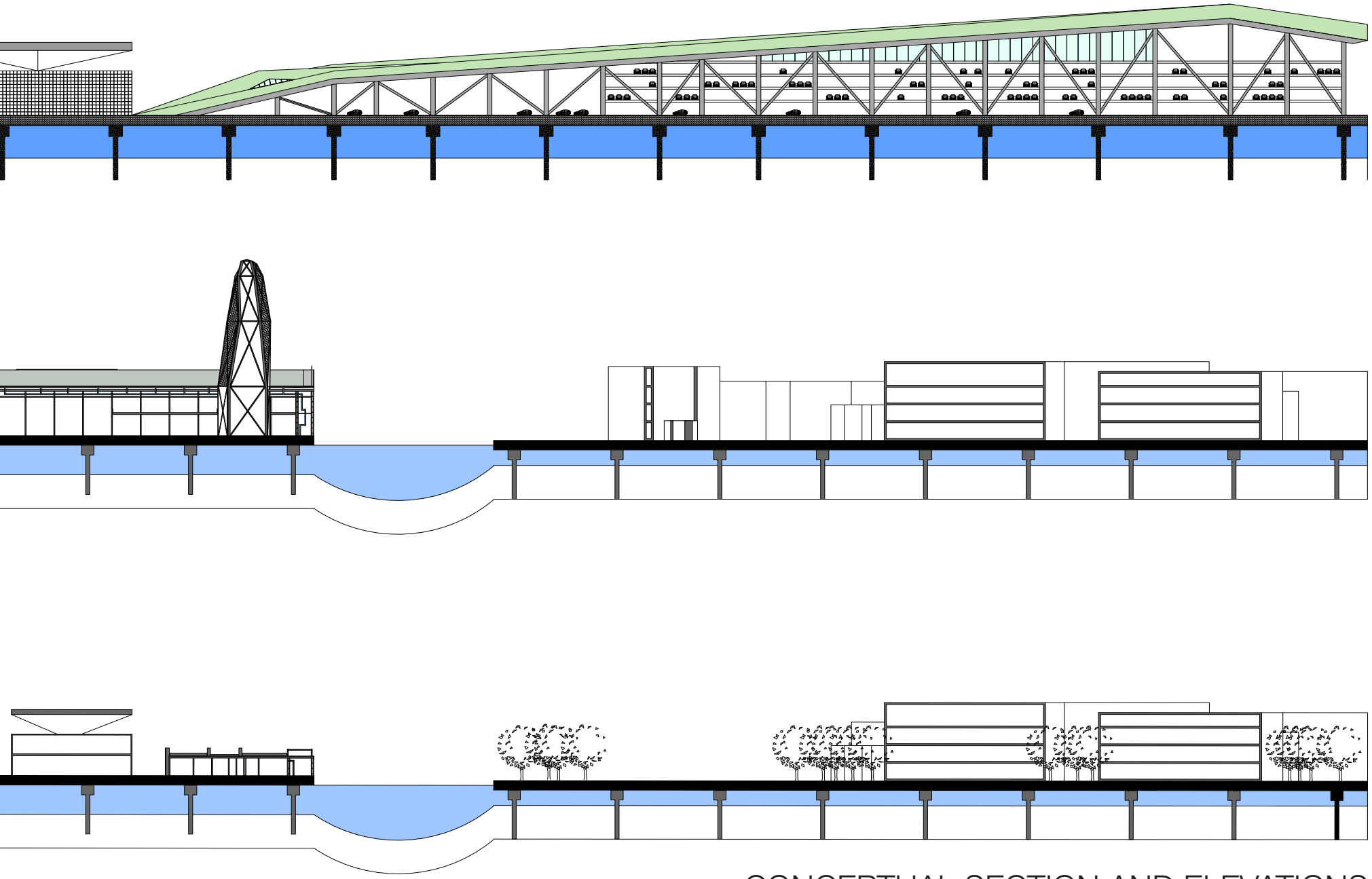
EAST ELEVATION



SOUTH ELEVATION



CROSS SECTION LOOKING NORTH



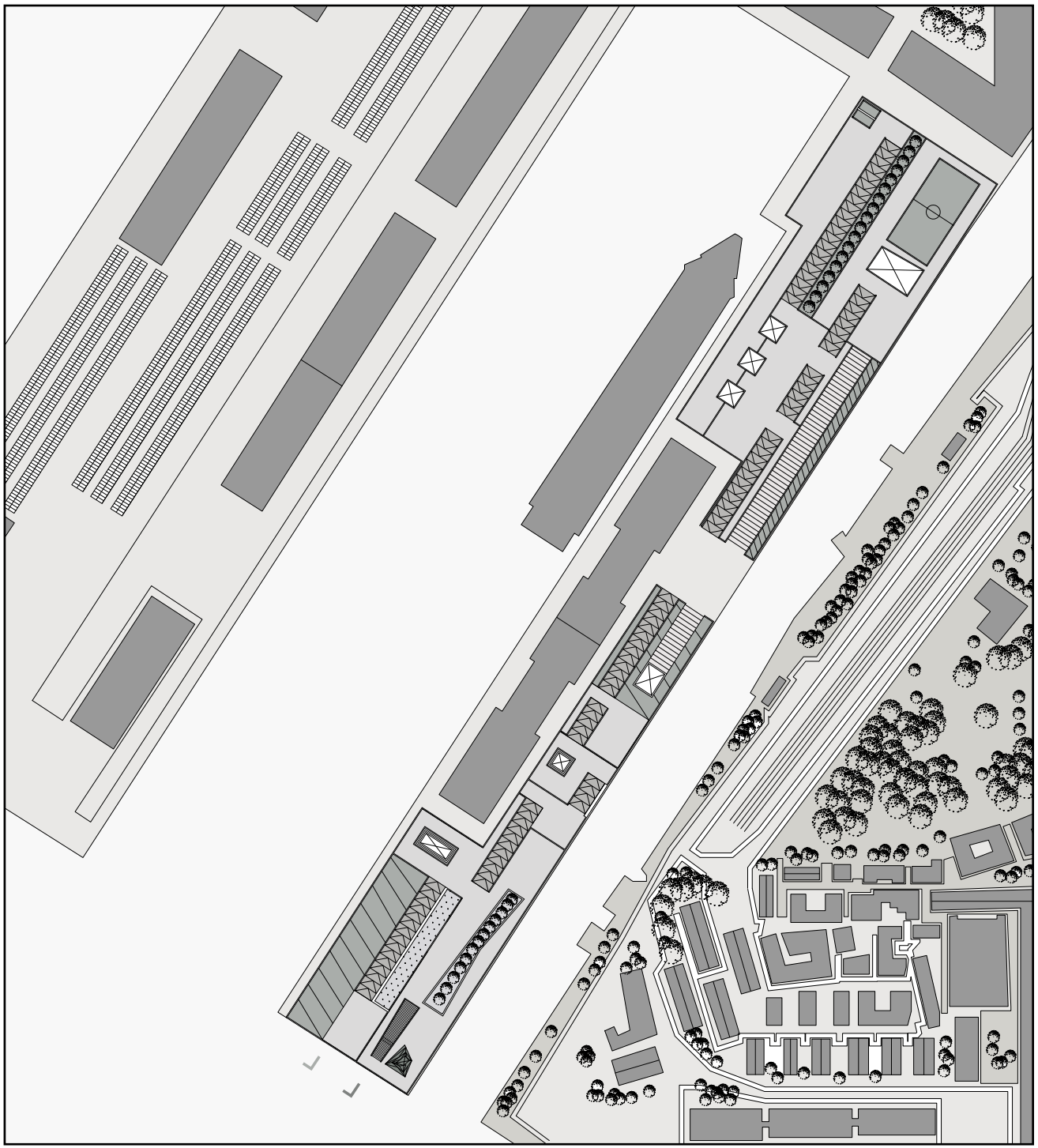
CONCEPTUAL SECTION AND ELEVATIONS

II.

CONCEPTUAL FRAMEWORK

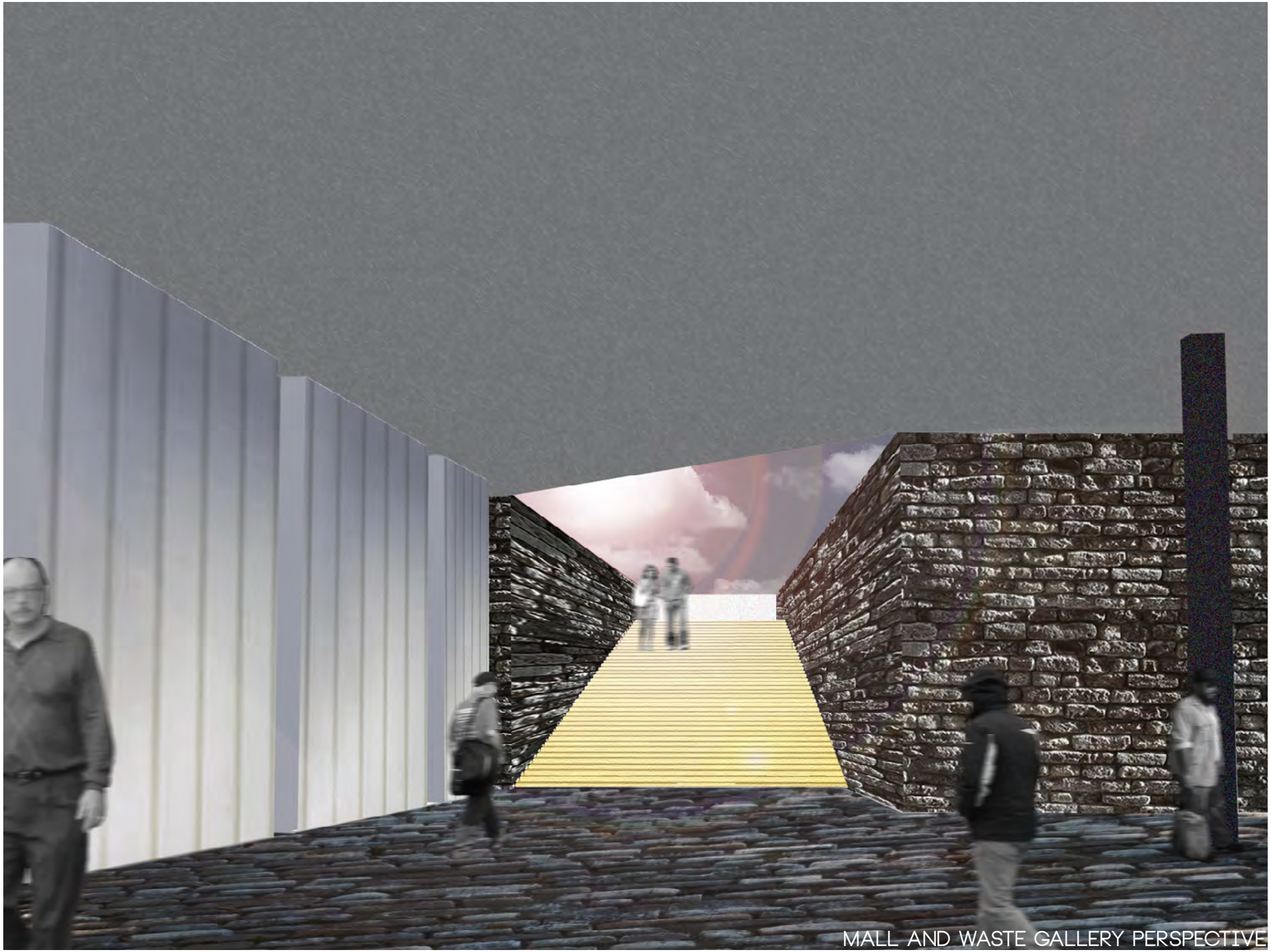
MID-REVIEW

WASTE MANAGEMENT FACILITY
RETAIL/RESTAURANTS
BATHROOMS
PARKING
TOURIST OFFICE



WATER FOLLY
CITY FOLLY
REFLECTING POOL
SOCCER FIELD
VIEWING PLATFORM

FOLLY AND PARK PERSPECTIVE

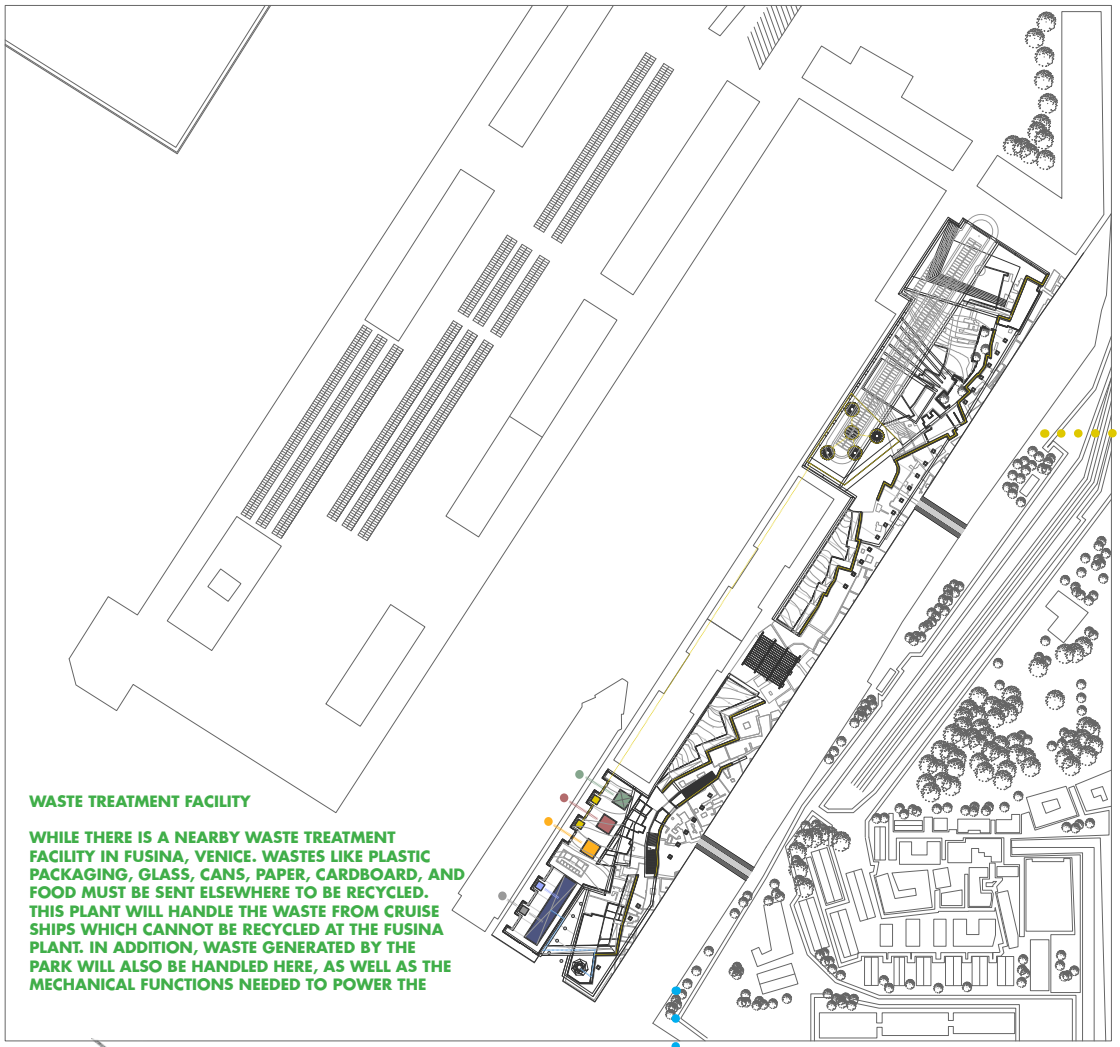


MALL AND WASTE GALLERY PERSPECTIVE

III.

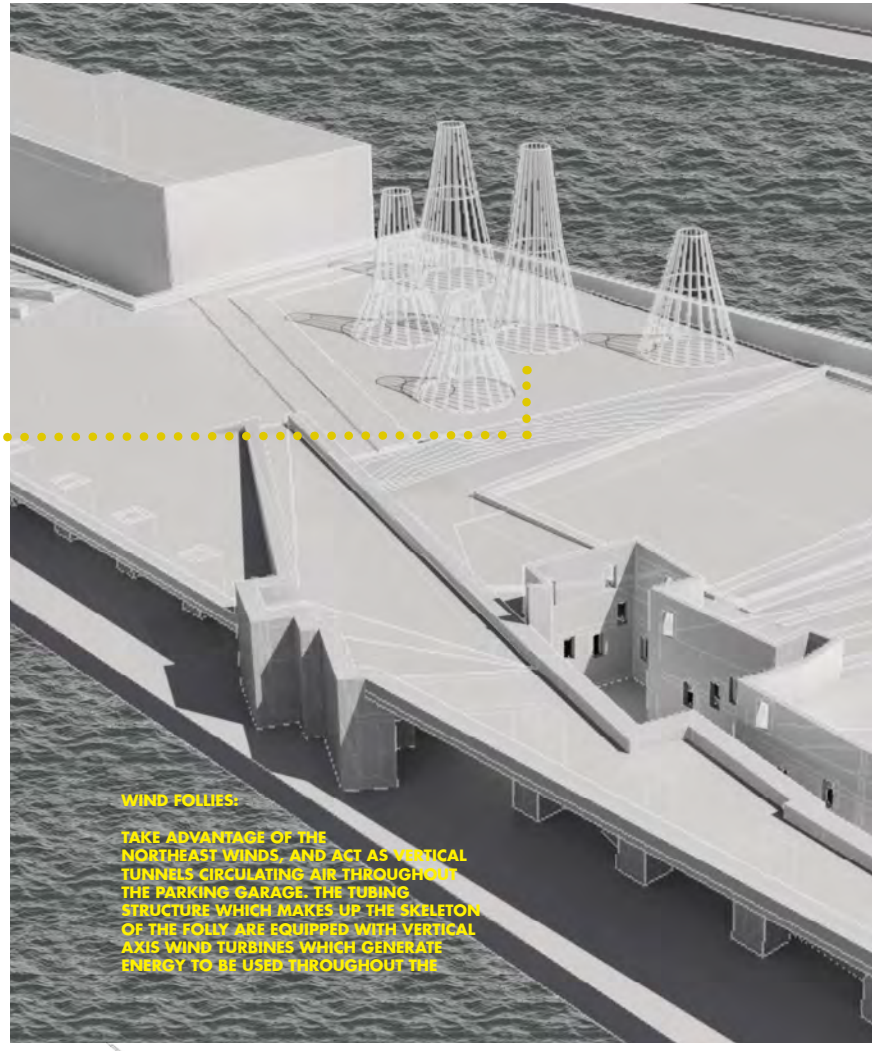
CONCEPTUAL FRAMEWORK

GATE REVIEW



WASTE TREATMENT FACILITY

WHILE THERE IS A NEARBY WASTE TREATMENT FACILITY IN FUSINA, VENICE. WASTES LIKE PLASTIC PACKAGING, GLASS, CANS, PAPER, CARDBOARD, AND FOOD MUST BE SENT ELSEWHERE TO BE RECYCLED. THIS PLANT WILL HANDLE THE WASTE FROM CRUISE SHIPS WHICH CANNOT BE RECYCLED AT THE FUSINA PLANT. IN ADDITION, WASTE GENERATED BY THE PARK WILL ALSO BE HANDLED HERE, AS WELL AS THE MECHANICAL FUNCTIONS NEEDED TO POWER THE



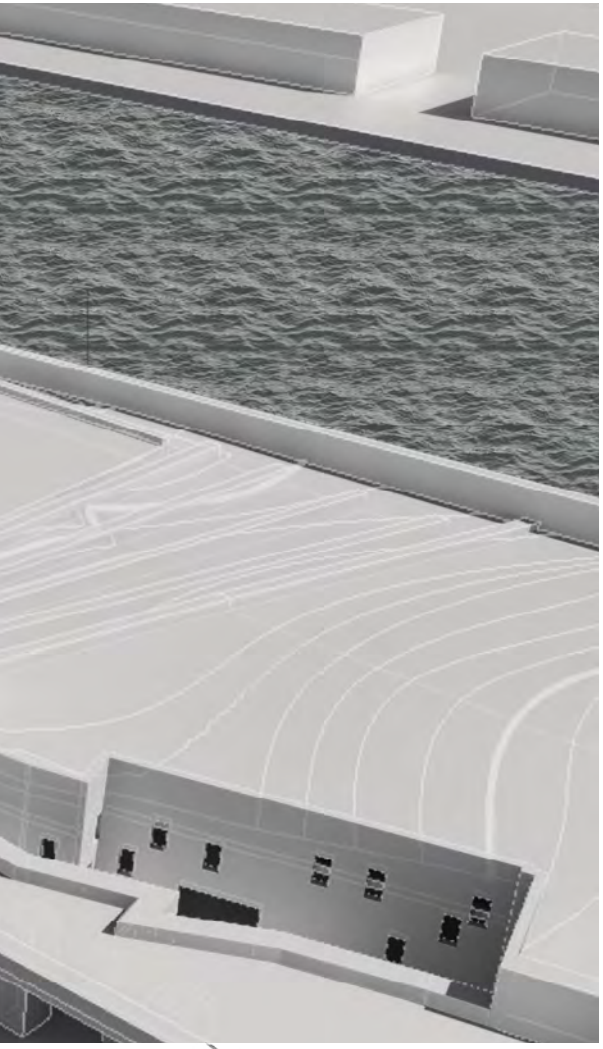
WIND FOLLIES:

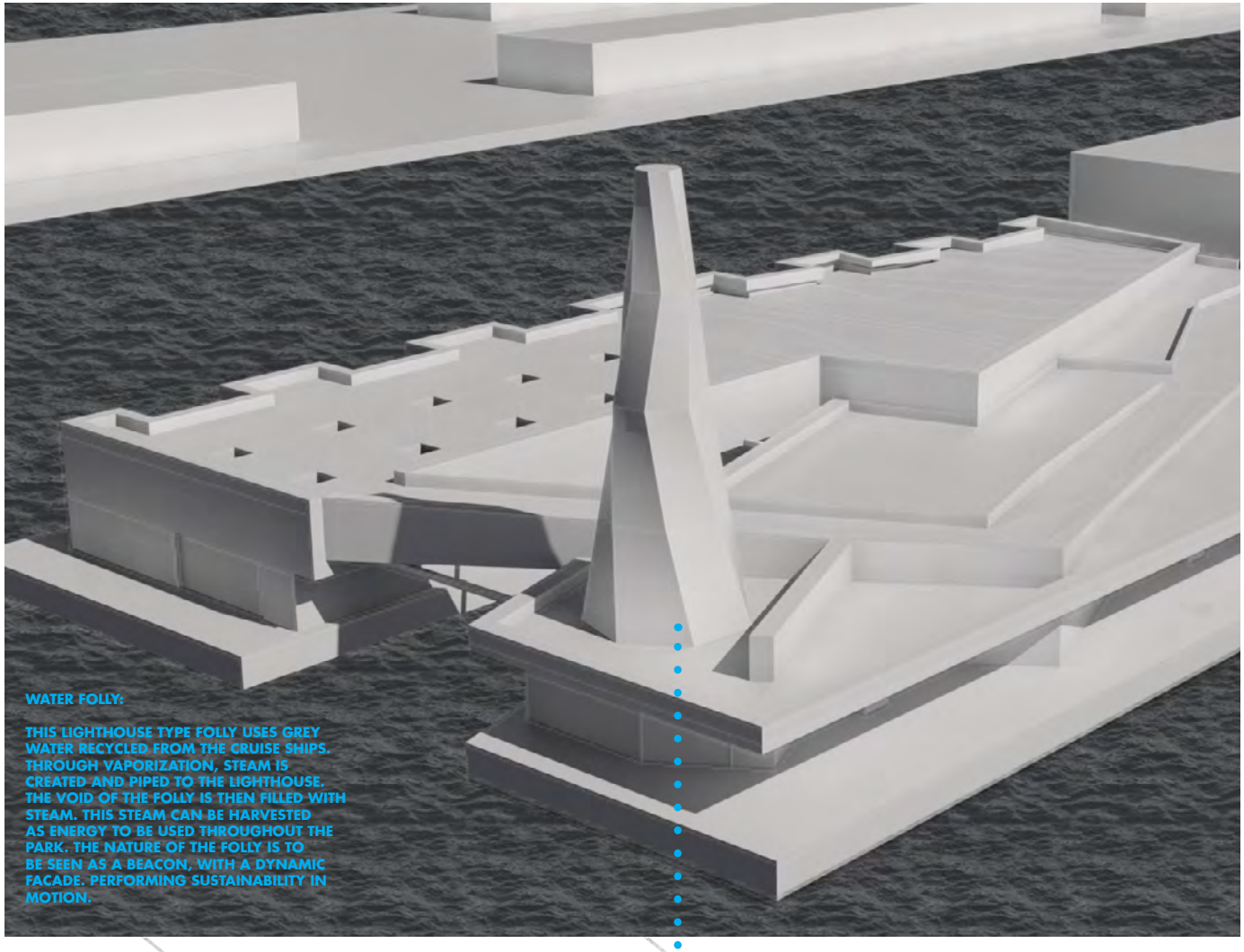
TAKE ADVANTAGE OF THE NORTHEAST WINDS, AND ACT AS VERTICAL TUNNELS CIRCULATING AIR THROUGHOUT THE PARKING GARAGE. THE TUBING STRUCTURE WHICH MAKES UP THE SKELETON OF THE FOLLY ARE EQUIPPED WITH VERTICAL AXIS WIND TURBINES WHICH GENERATE ENERGY TO BE USED THROUGHOUT THE

VENICE CALLOUT

SURROUNDING GREENSPACE

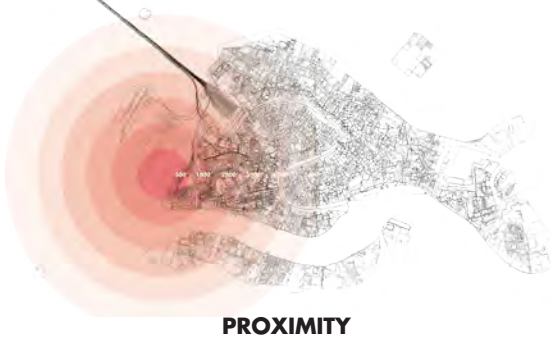
IMPORTANT PLACES





WATER FOLLY:

THIS LIGHTHOUSE TYPE FOLLY USES GREY WATER RECYCLED FROM THE CRUISE SHIPS. THROUGH VAPORIZATION, STEAM IS CREATED AND PIPED TO THE LIGHTHOUSE. THE VOID OF THE FOLLY IS THEN FILLED WITH STEAM. THIS STEAM CAN BE HARVESTED AS ENERGY TO BE USED THROUGHOUT THE PARK. THE NATURE OF THE FOLLY IS TO BE SEEN AS A BEACON, WITH A DYNAMIC FACADE. PERFORMING SUSTAINABILITY IN MOTION.



PROXIMITY

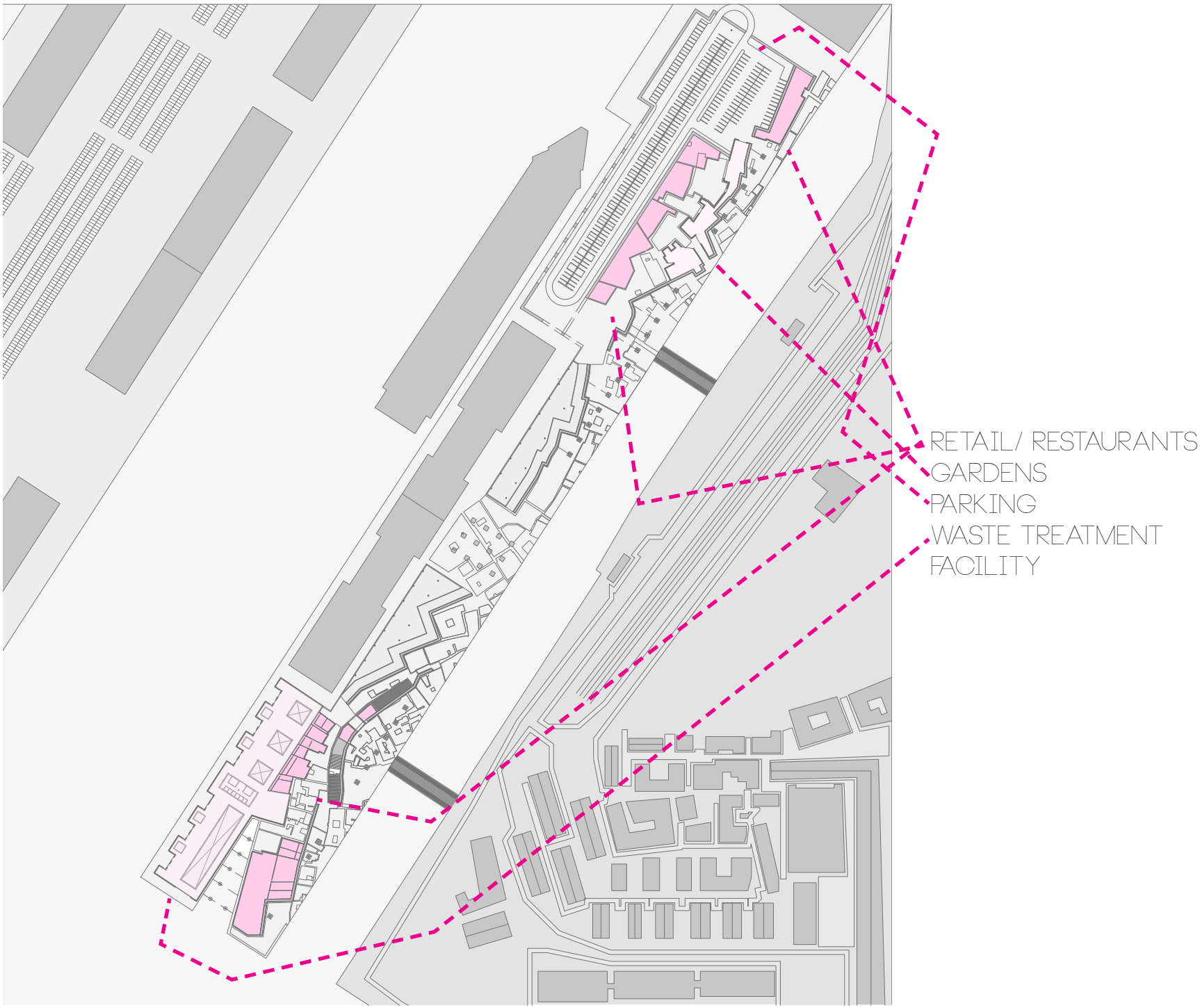
NOTABLE PLACES

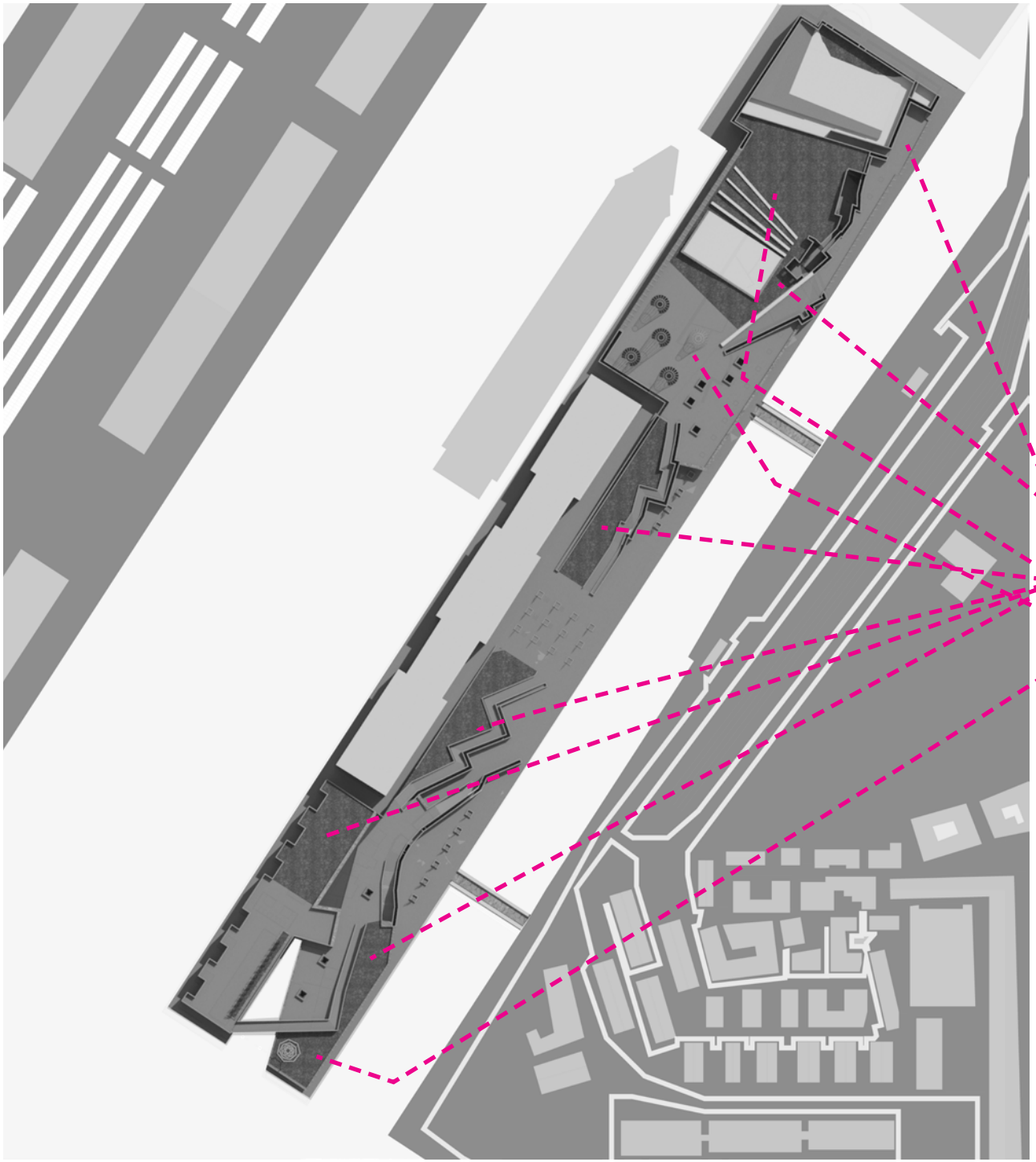
TRANSPORTATION

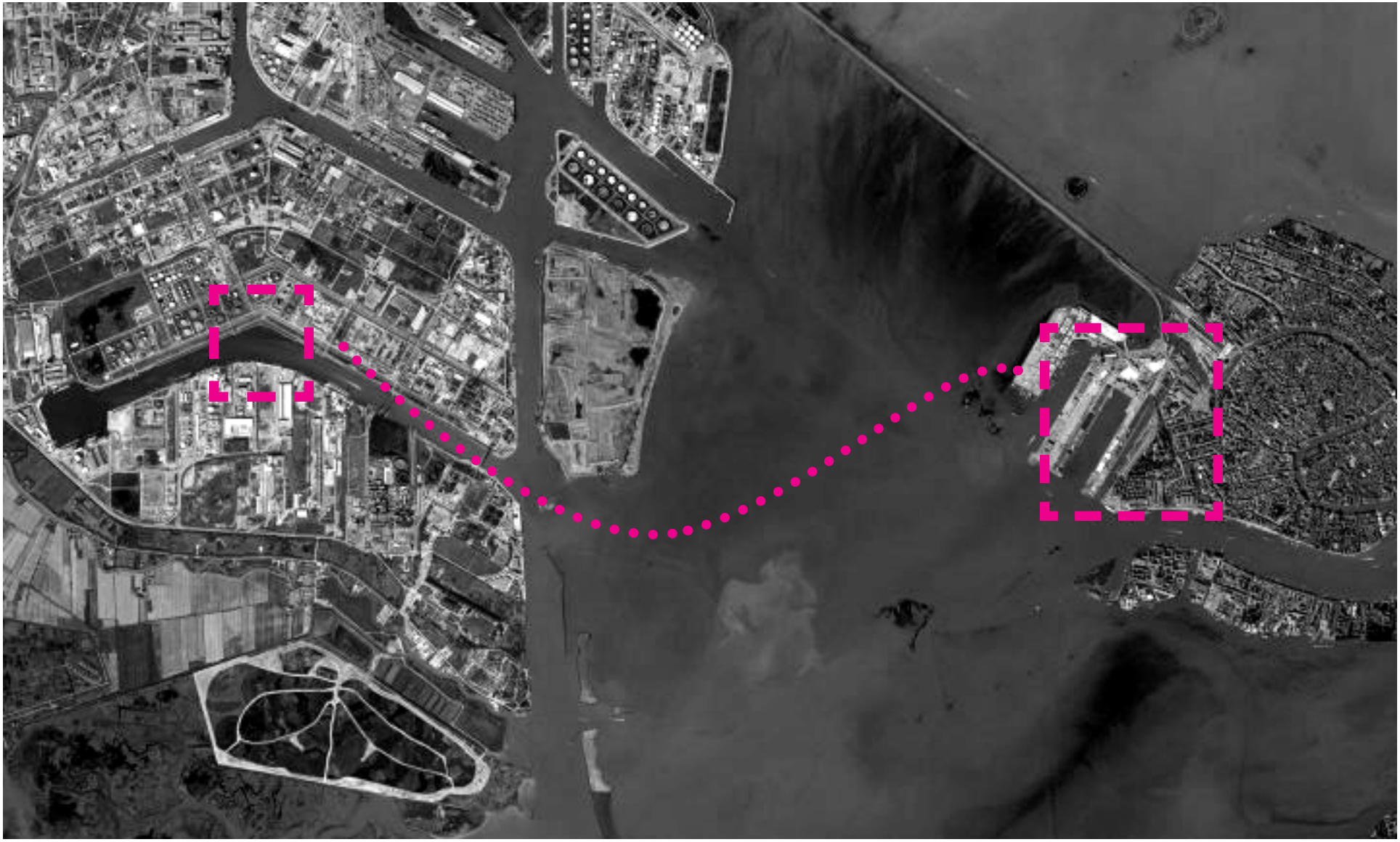
IV.

CONCEPTUAL FRAMEWORK

FINAL REVIEW


RETAIL/ RESTAURANTS
GARDENS
PARKING
WASTE TREATMENT FACILITY


RECREATIONAL
FIELDS
LEISURE FIELDS
WIND FOLLIES
WATER FOLLY

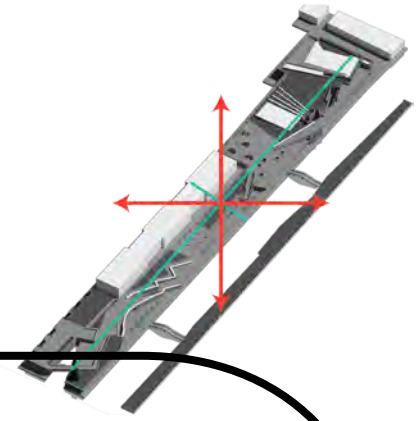


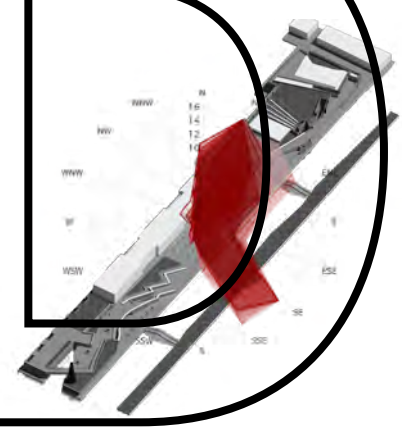
CRUISE VESSEL WASTE TREATMENT FACILITY

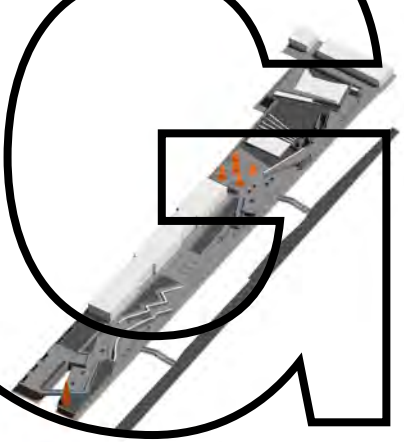
ONLY HANDLES RESIDUAL WASTE
(WASTE UNABLE TO BE RECYCLED, REUSED, OR COMPOSTED)

WASTE TREATMENT FACILITY

WHILE THERE IS A NEARBY WASTE TREATMENT FACILITY IN FUSINA, VENICE. WASTES LIKE PLASTIC PACKAGING, GLASS, CANS, PAPER, CARDBOARD, AND FOOD MUST BE SENT ELSEWHERE TO BE RECYCLED. THIS PLANT WILL HANDLE THE WASTE FROM CRUISE SHIPS WHICH CANNOT BE RECYCLED AT THE FUSINA PLANT. IN ADDITION, WASTE GENERATED BY THE PARK WILL ALSO BE HANDLED HERE, AS WELL AS THE MECHANICAL FUNCTIONS NEEDED TO POWER THE PARK.



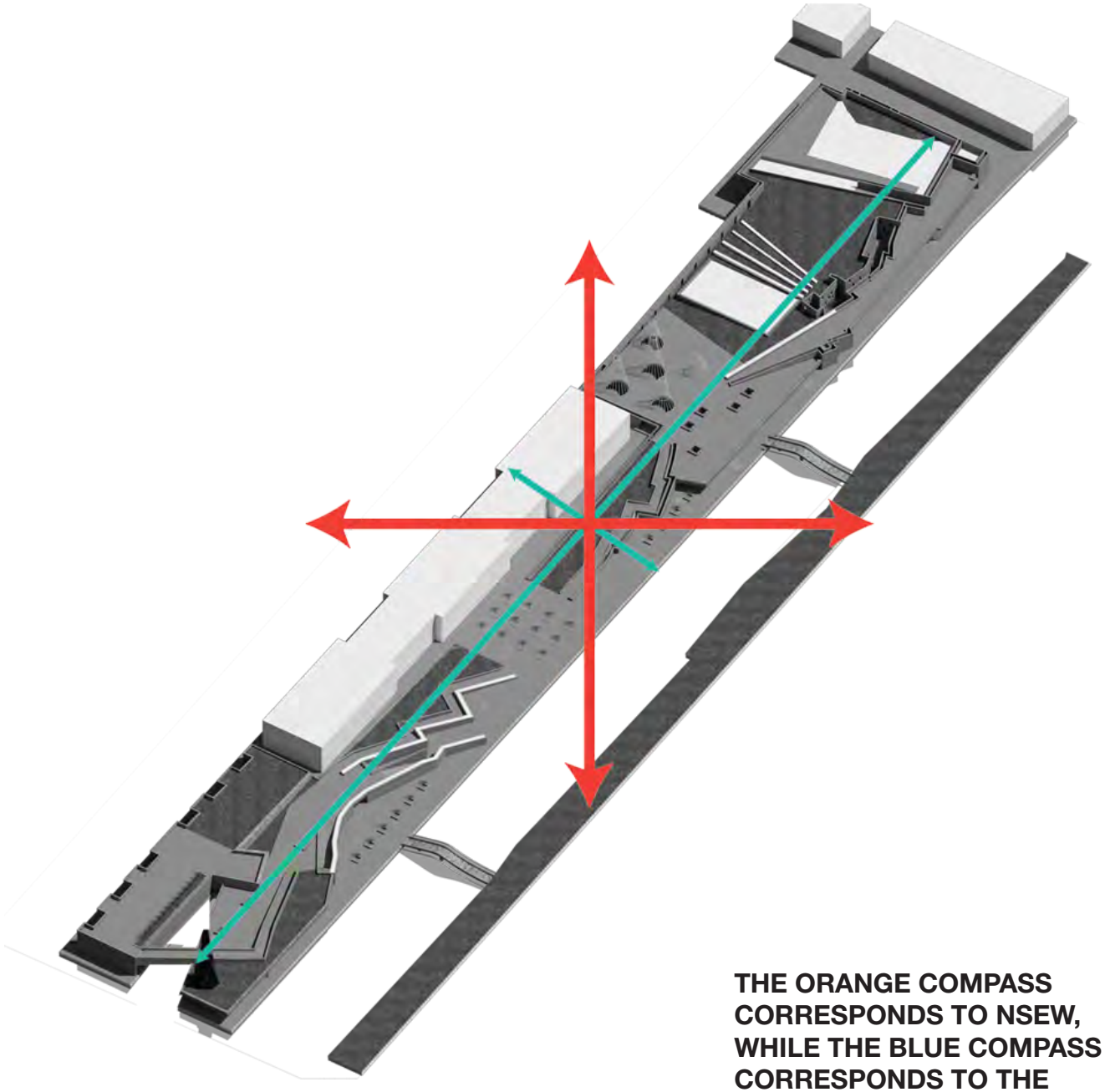





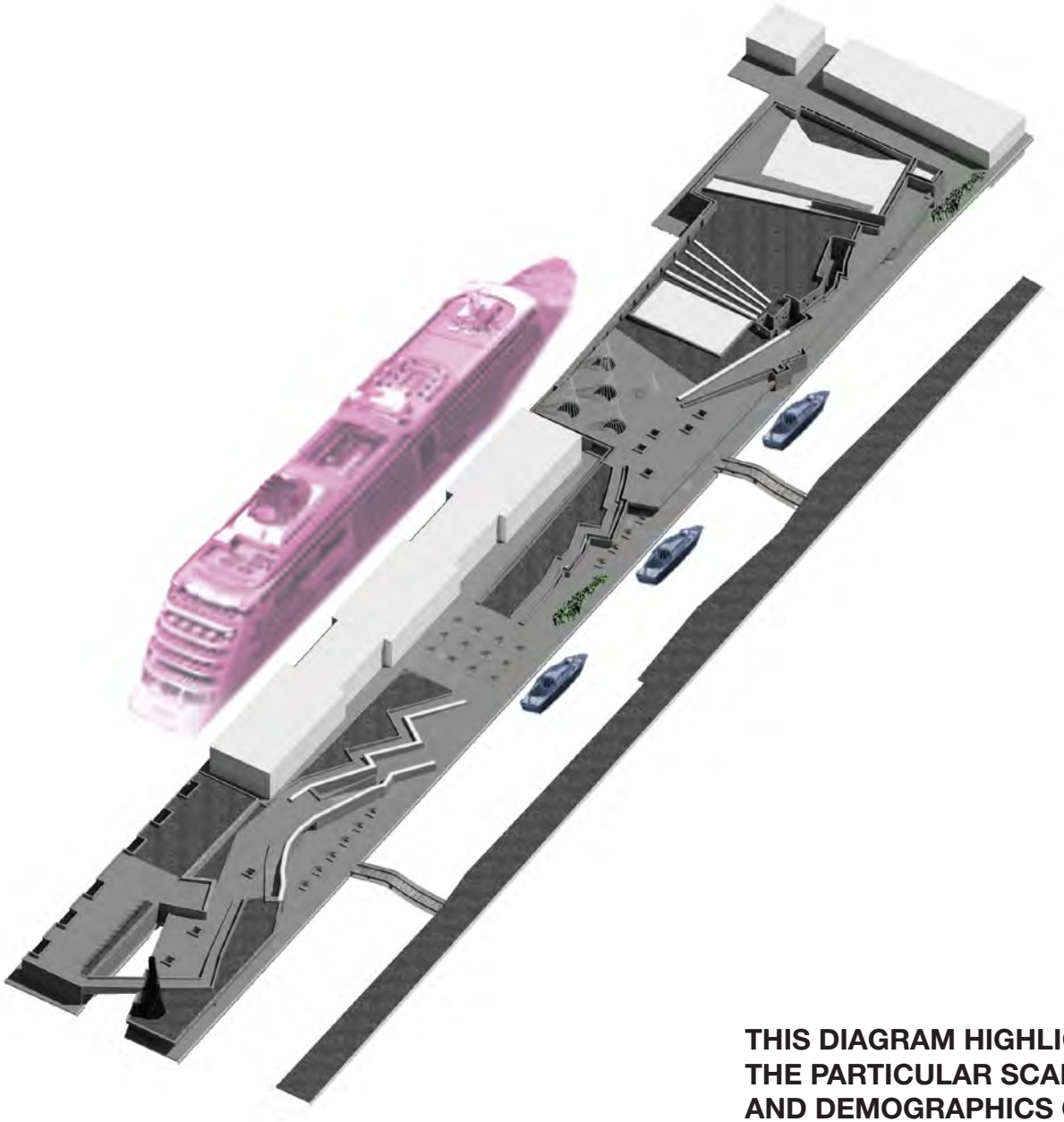
DIAGR




RAMS

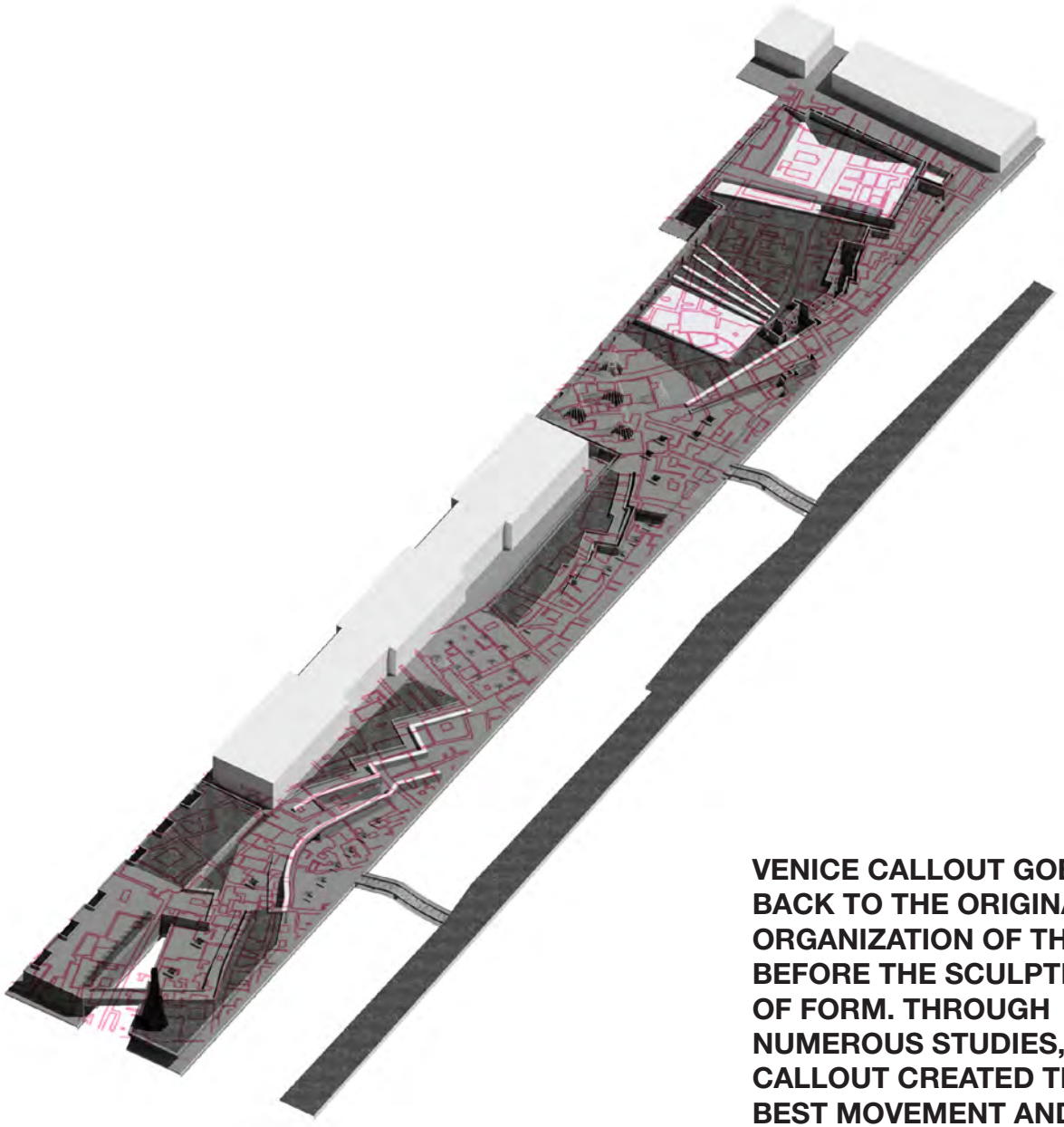


THE ORANGE COMPASS CORRESPONDS TO NSEW, WHILE THE BLUE COMPASS CORRESPONDS TO THE PARALLELS TO THE ACTUAL SITE.



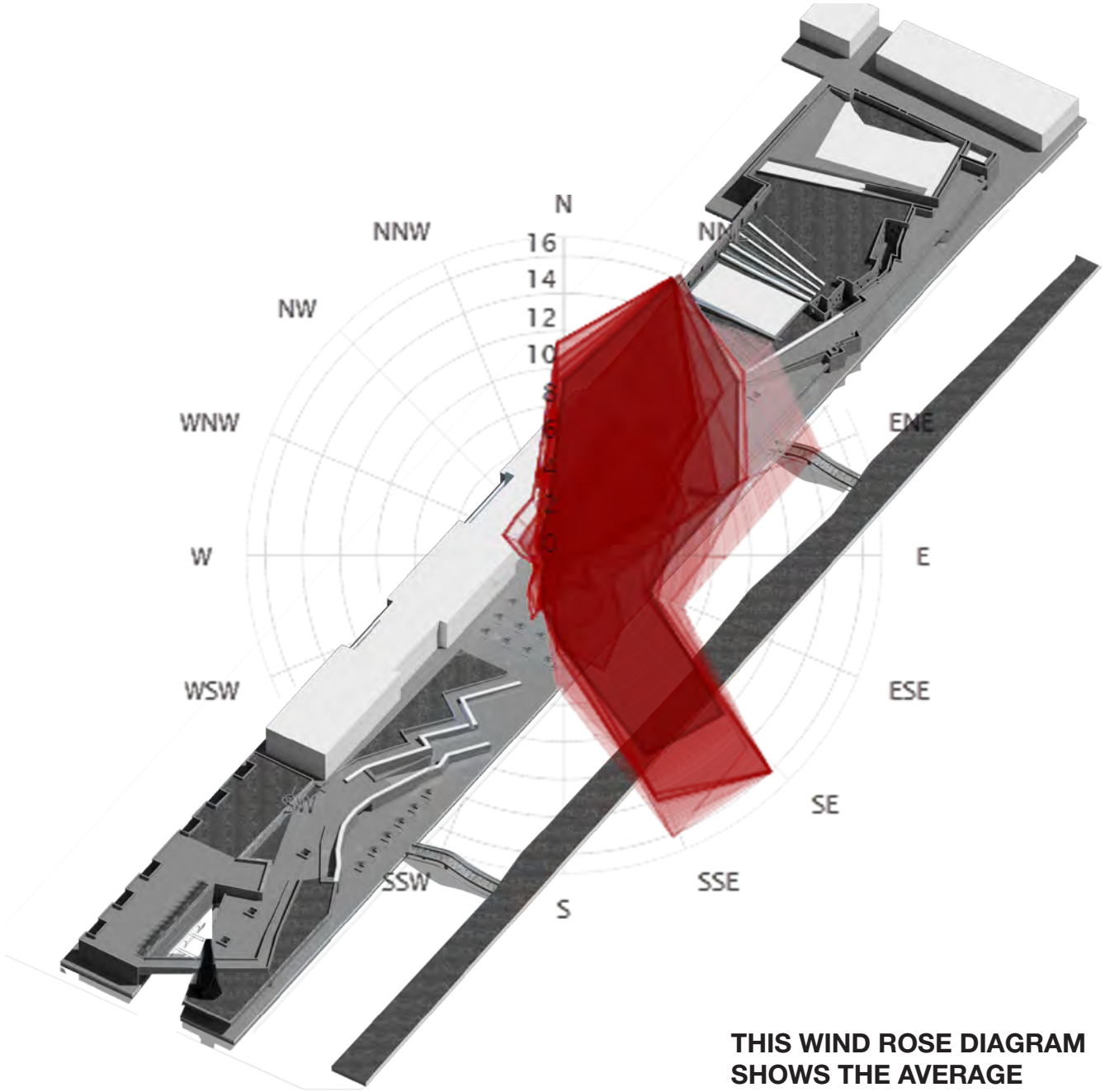
THIS DIAGRAM HIGHLIGHTS THE PARTICULAR SCALE AND DEMOGRAPHICS OF PEDESTRIAN TRAVEL ON AND AROUND THE SITE.

TRANSPORTATION



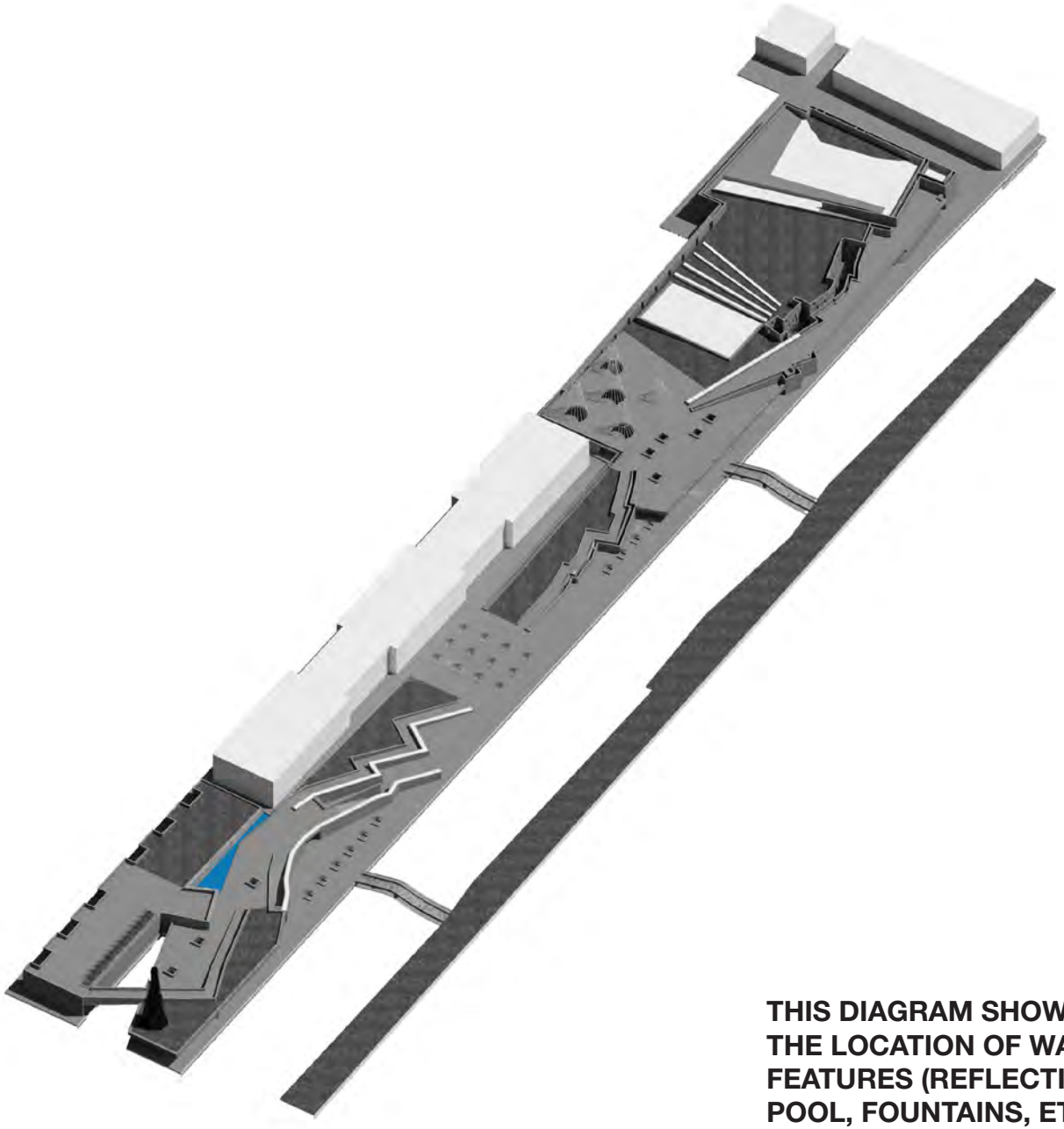
VENICE CALLOUT GOES BACK TO THE ORIGINAL ORGANIZATION OF THE SITE BEFORE THE SCULPTING OF FORM. THROUGH NUMEROUS STUDIES, THIS CALLOUT CREATED THE BEST MOVEMENT AND EXPRESSION OF FORM AS THE PROJECT EVOLVED.

VENICE CALLOUT



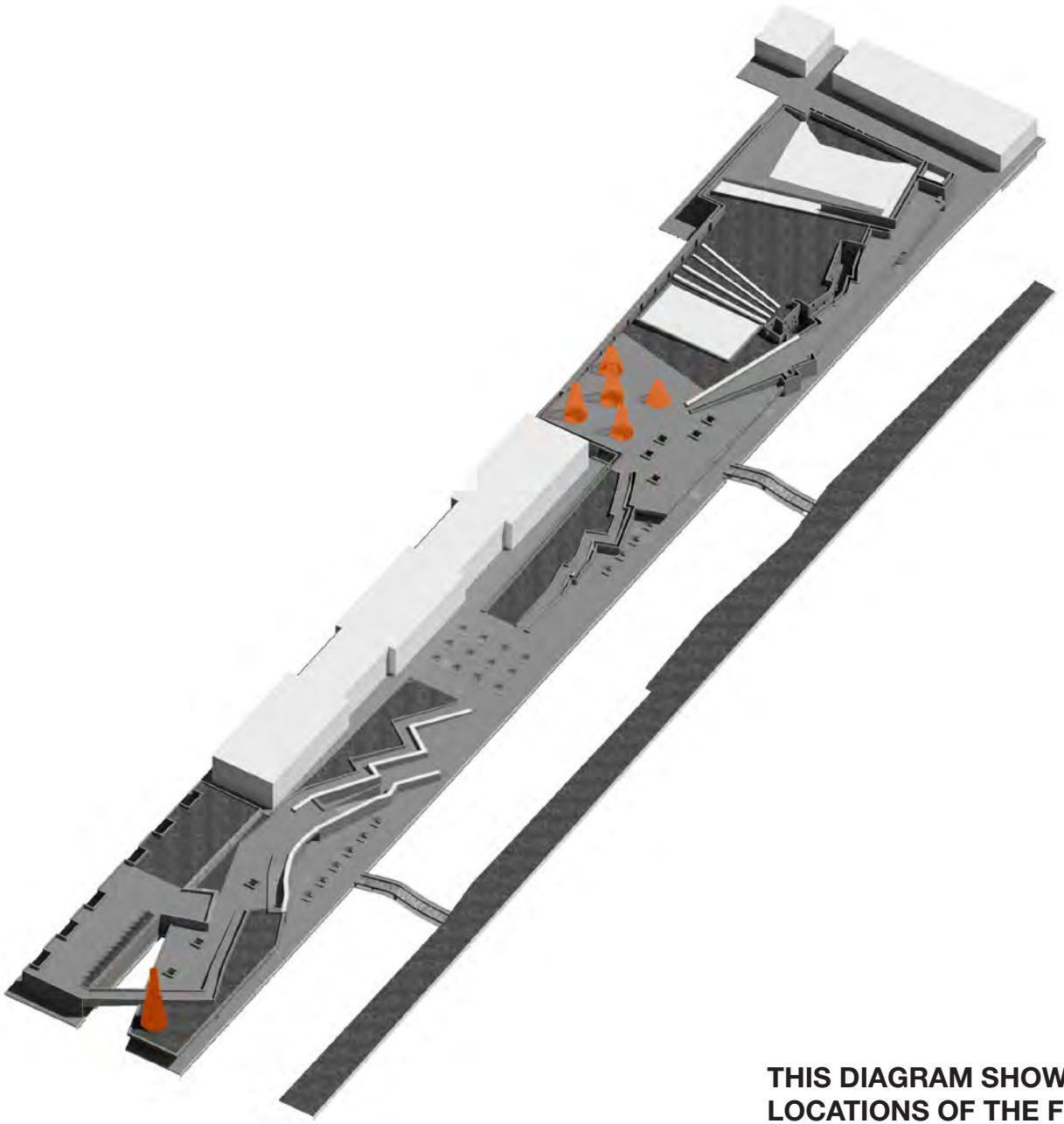
THIS WIND ROSE DIAGRAM SHOWS THE AVERAGE SPEED AND DIRECTION OF WIND YEAR ROUND IN VENICE, ITALY.

WIND ROSE



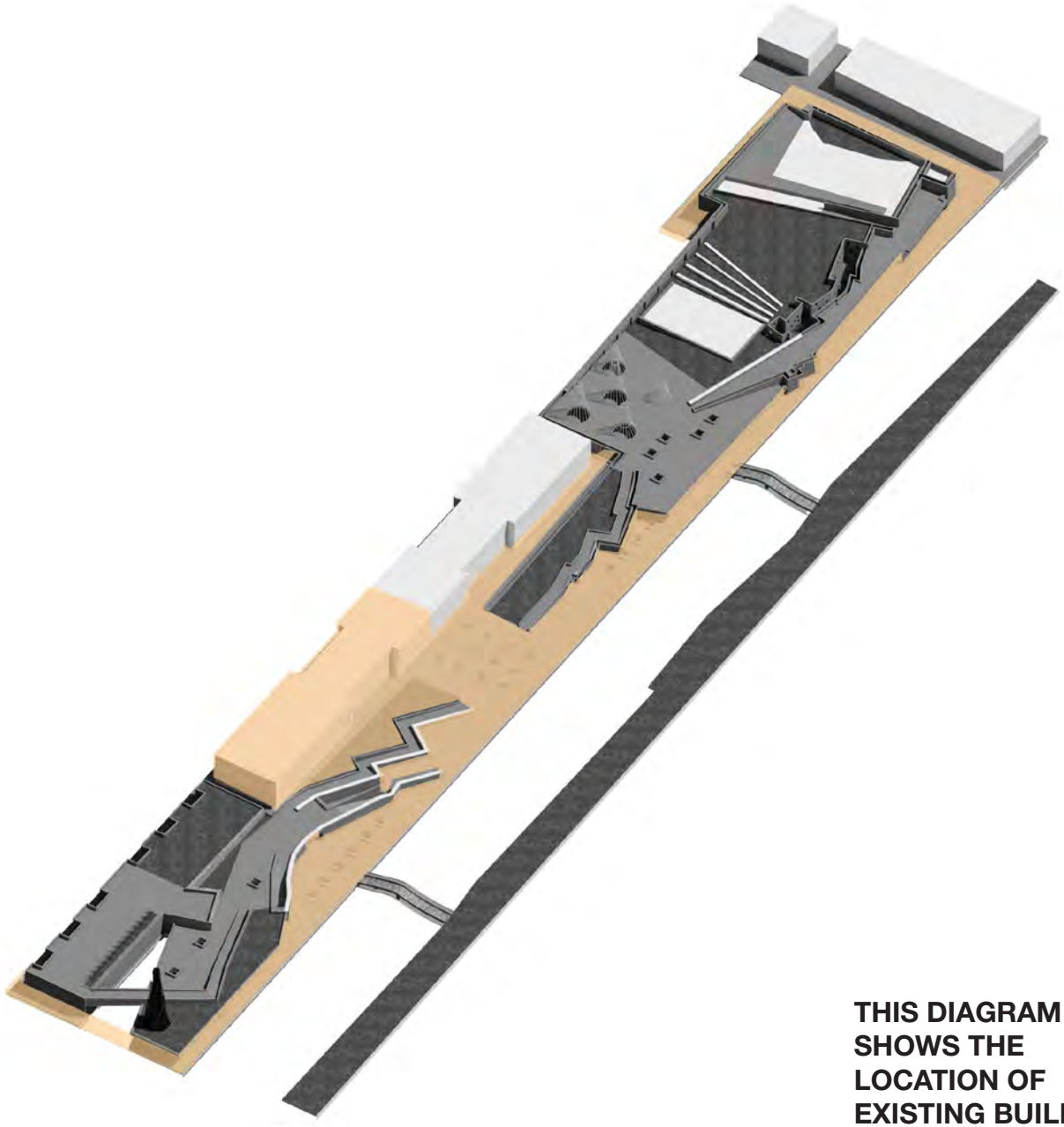
THIS DIAGRAM SHOWS THE LOCATION OF WATER FEATURES (REFLECTING POOL, FOUNTAINS, ETC) AROUND THE SITE.

WATER



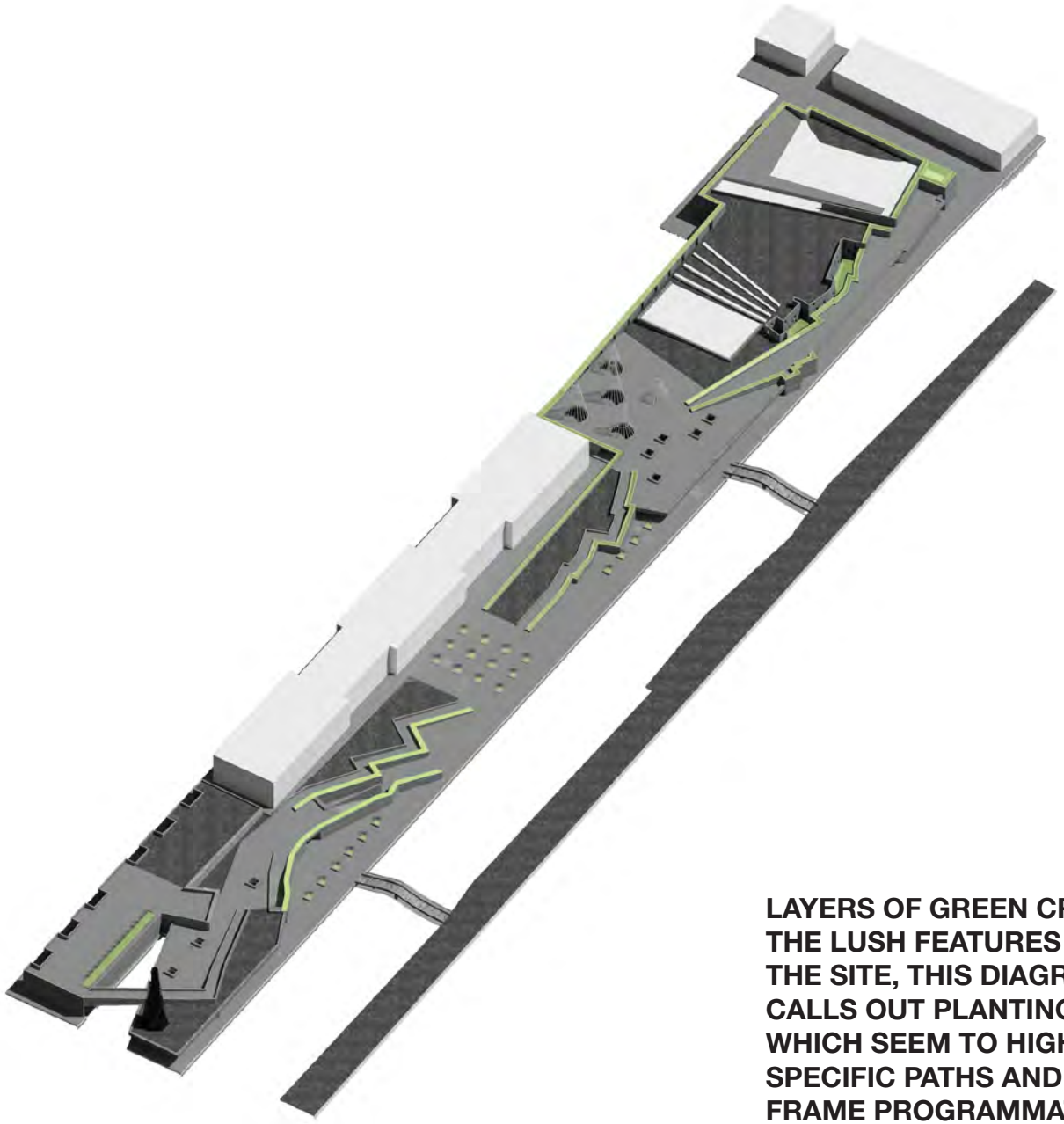
FOLLY LOCATION

THIS DIAGRAM SHOWS THE LOCATIONS OF THE FOLLY'S ON SITE.



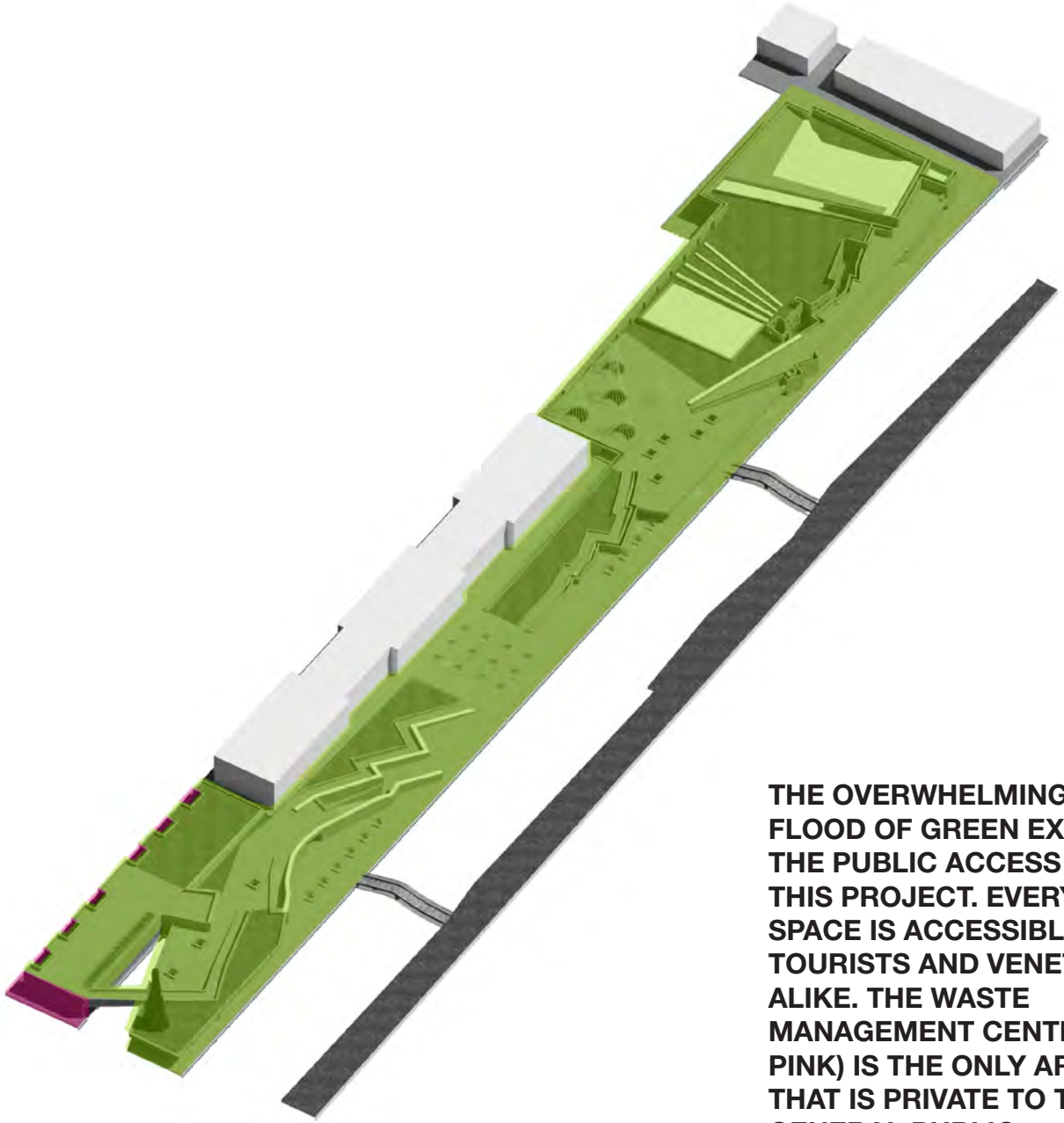
THIS DIAGRAM SHOWS THE LOCATION OF EXISTING BUILDINGS AND HARDSCAPE.

EXISTING



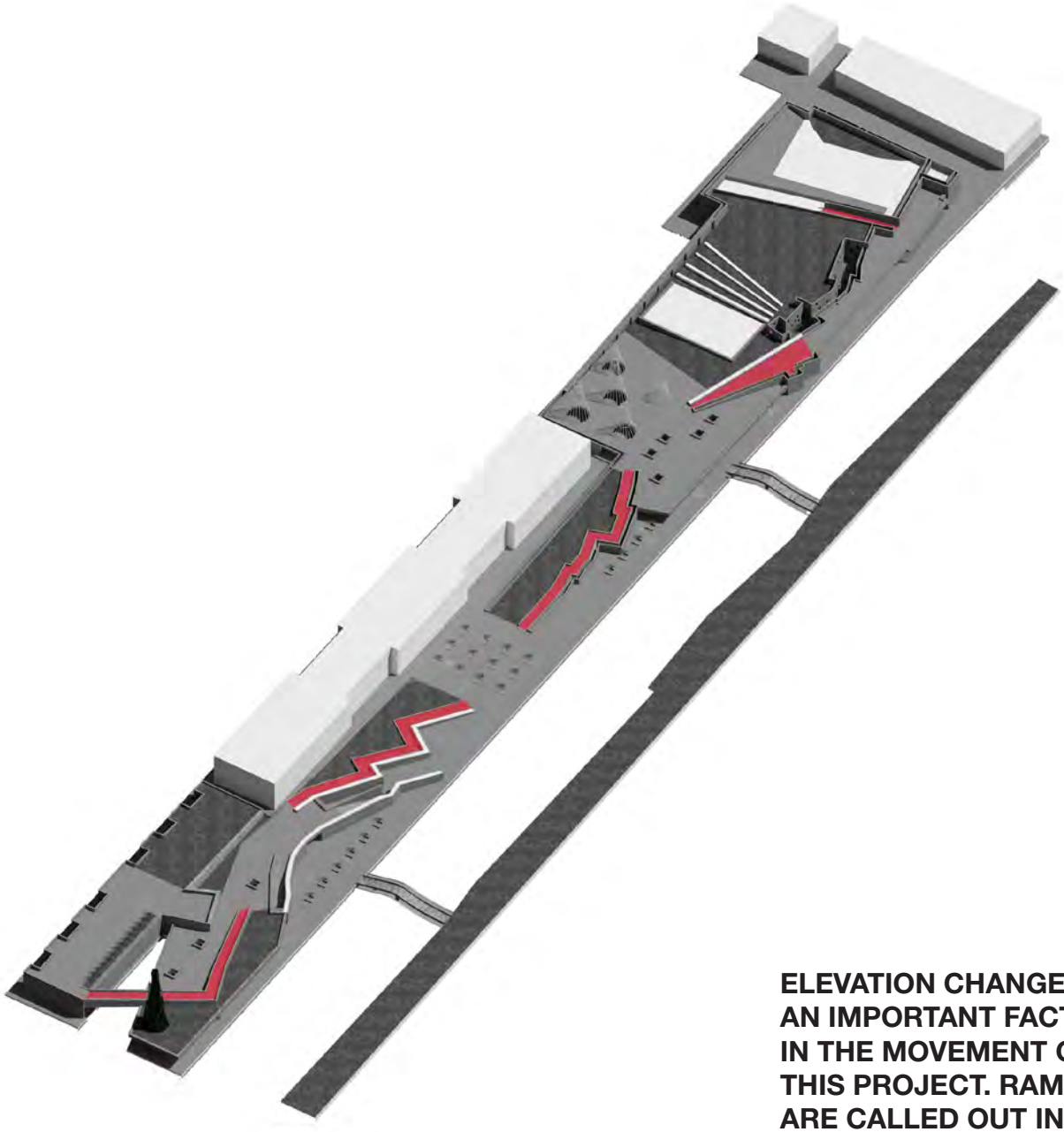
LAYERS OF GREEN CREATE THE LUSH FEATURES OF THE SITE, THIS DIAGRAM CALLS OUT PLANTING BEDS WHICH SEEM TO HIGHLIGHT SPECIFIC PATHS AND FRAME PROGRAMMATIC ELEMENTS.

PLANTING



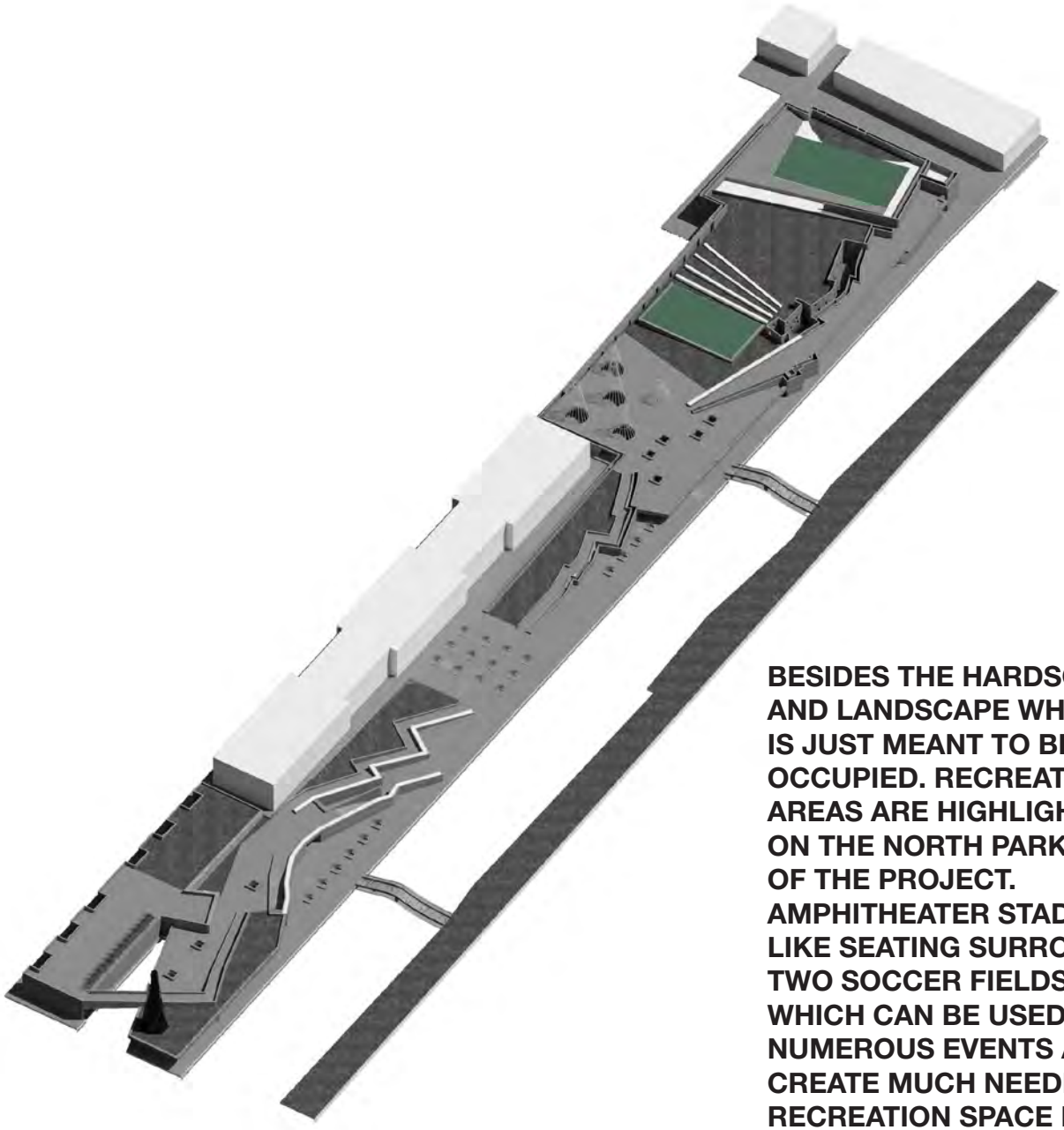
THE OVERWHELMING FLOOD OF GREEN EXPLAINS THE PUBLIC ACCESS OF THIS PROJECT. EVERY SPACE IS ACCESSIBLE TO TOURISTS AND VENETIANS ALIKE. THE WASTE MANAGEMENT CENTER (IN PINK) IS THE ONLY AREA THAT IS PRIVATE TO THE GENERAL PUBLIC.

PUBLIC VS. PRIVATE



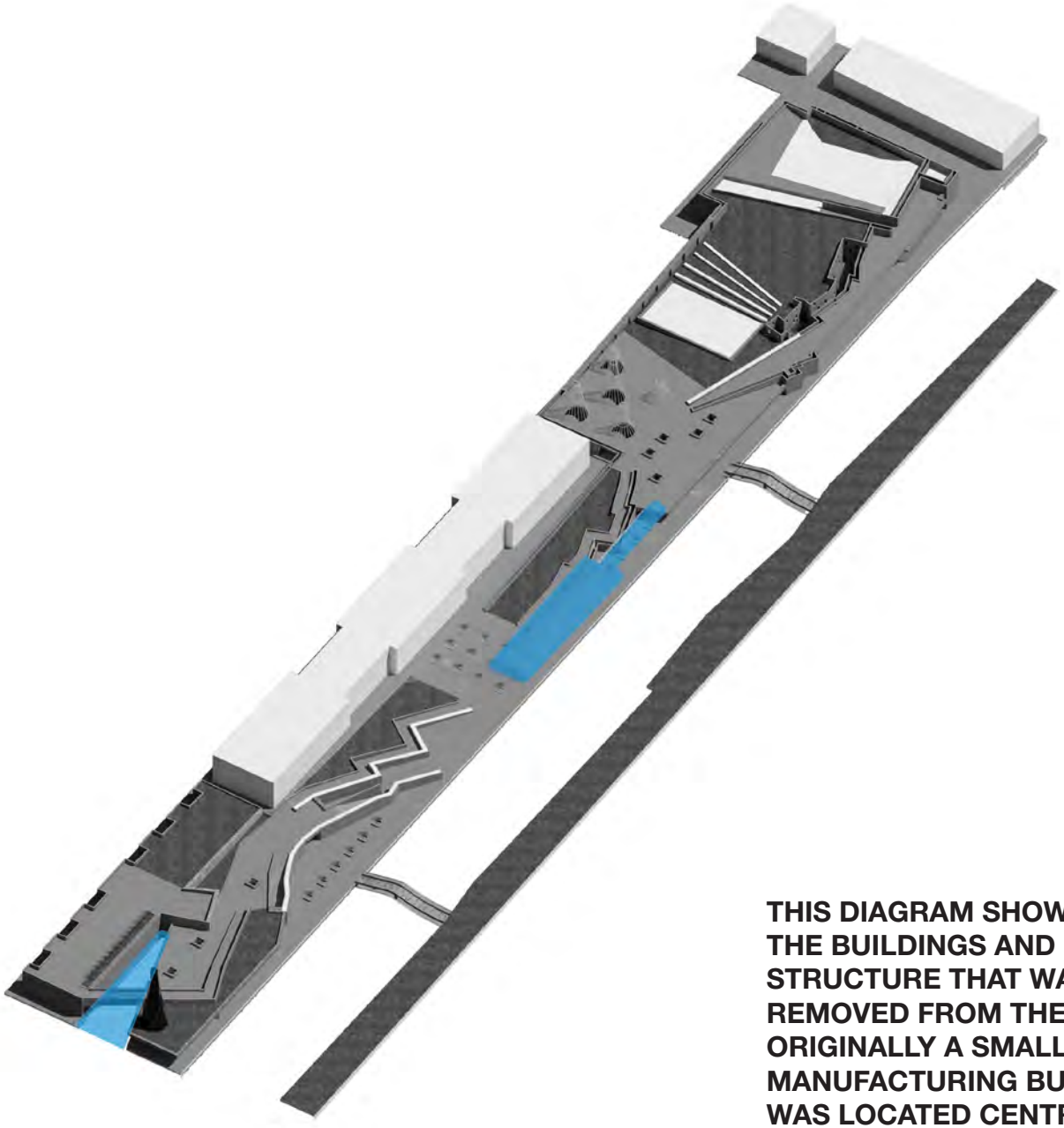
ELEVATION CHANGE IS AN IMPORTANT FACTOR IN THE MOVEMENT OF THIS PROJECT. RAMPS ARE CALLED OUT IN THIS DIAGRAM.

RAMPS



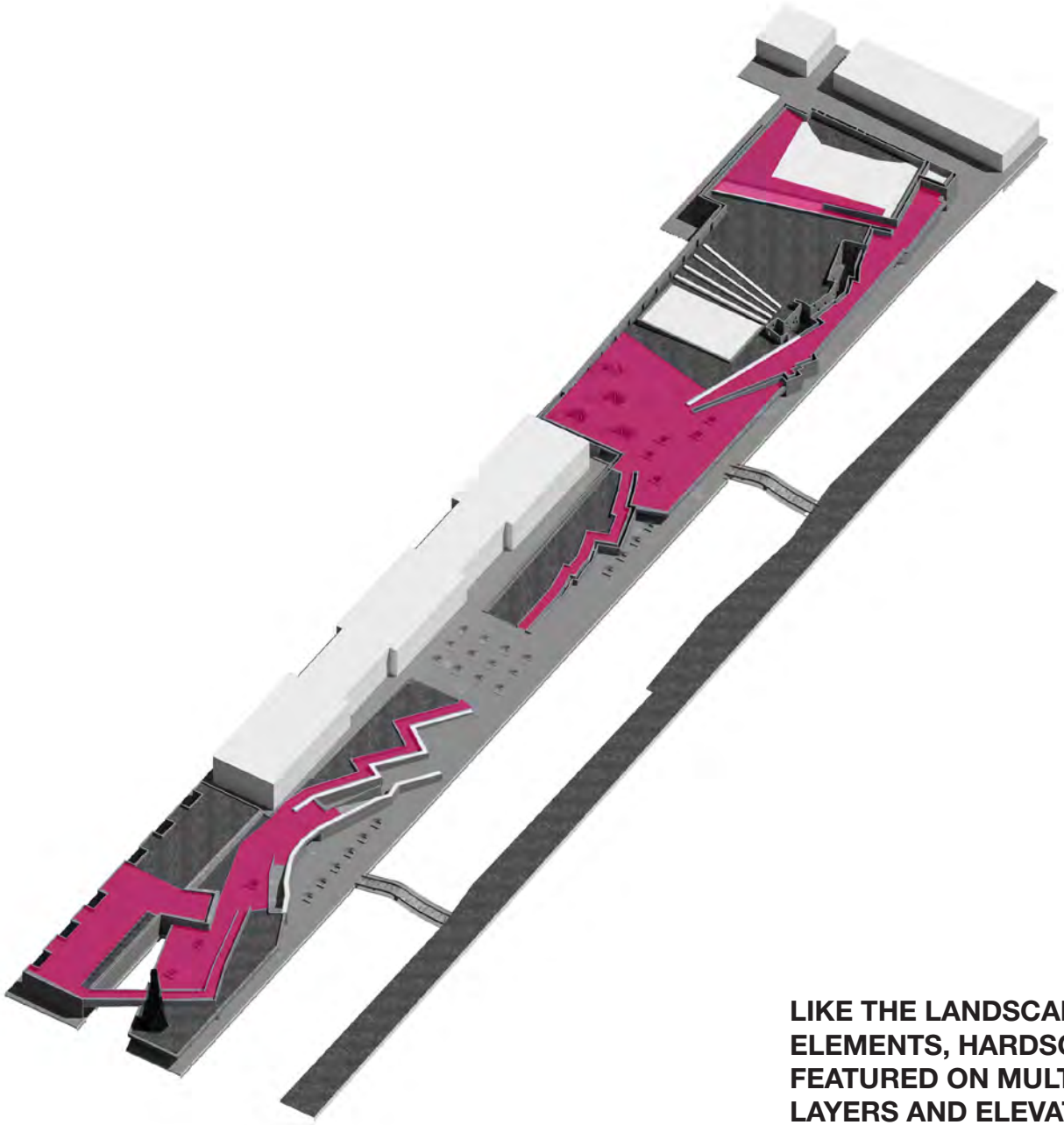
BESIDES THE HARDSCAPE AND LANDSCAPE WHICH IS JUST MEANT TO BE OCCUPIED. RECREATIONAL AREAS ARE HIGHLIGHTED ON THE NORTH PARK OF THE PROJECT. AMPHITHEATER STADIUM LIKE SEATING SURROUNDS TWO SOCCER FIELDS WHICH CAN BE USED FOR NUMEROUS EVENTS AND CREATE MUCH NEEDED RECREATION SPACE IN VENICE.

RECREATION



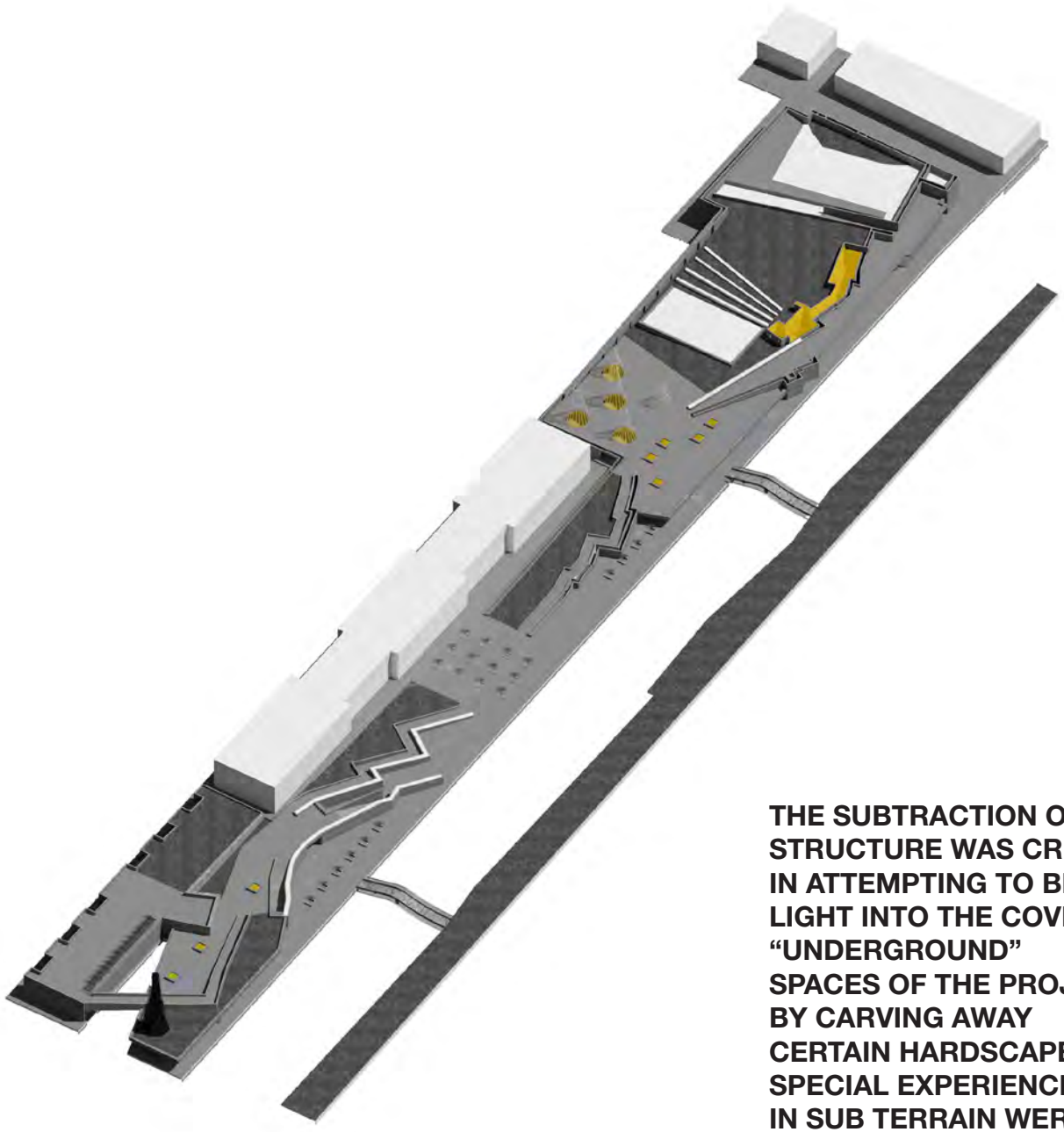
REMOVED

THIS DIAGRAM SHOWS THE BUILDINGS AND STRUCTURE THAT WAS REMOVED FROM THE SIGHT. ORIGINALLY A SMALL MANUFACTURING BUILDING WAS LOCATED CENTRALLY ON THE SITE.



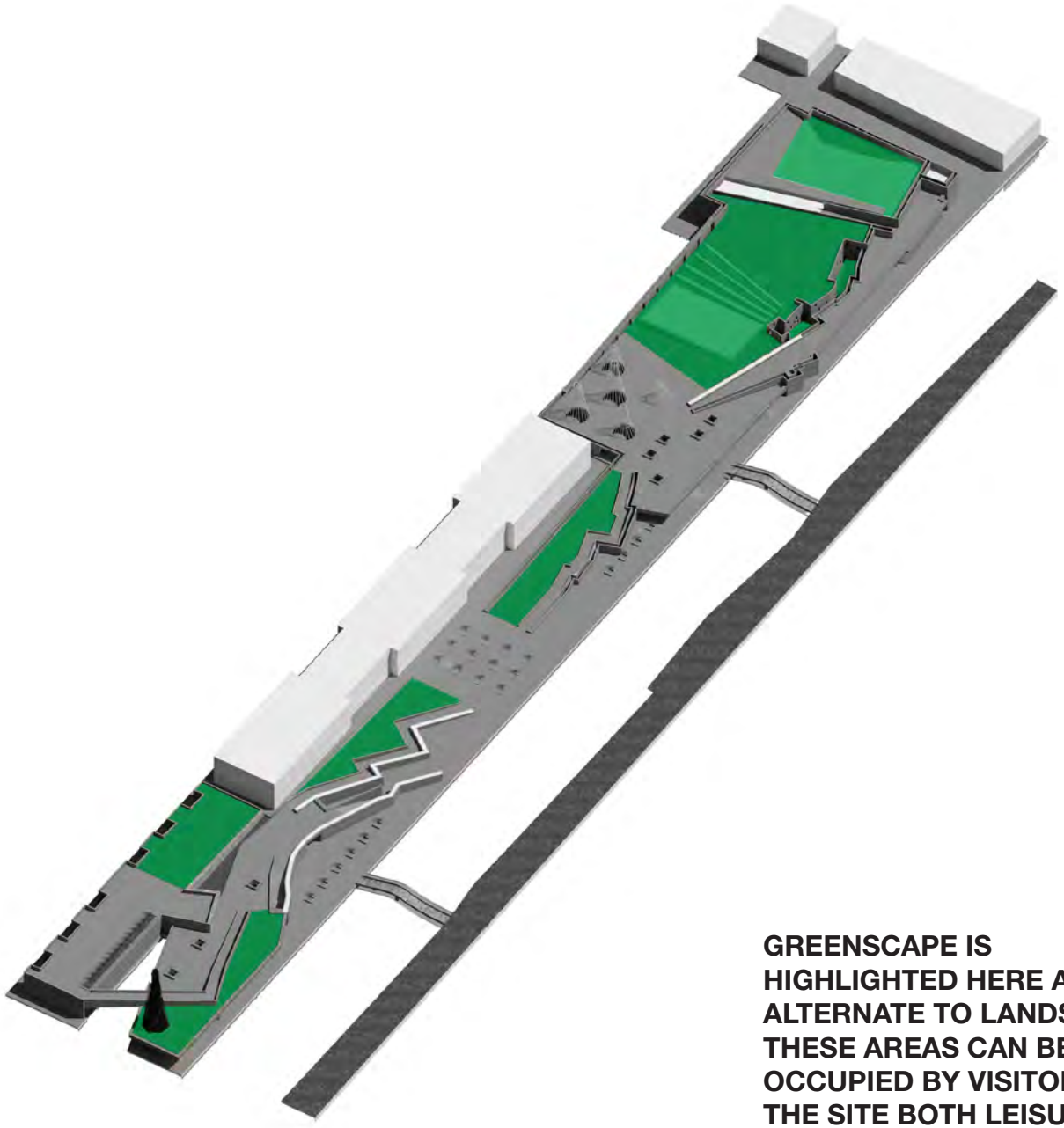
LIKE THE LANDSCAPE ELEMENTS, HARDSCAPE IS FEATURED ON MULTIPLE LAYERS AND ELEVATIONS ON THE SITE.

HARDSCAPE



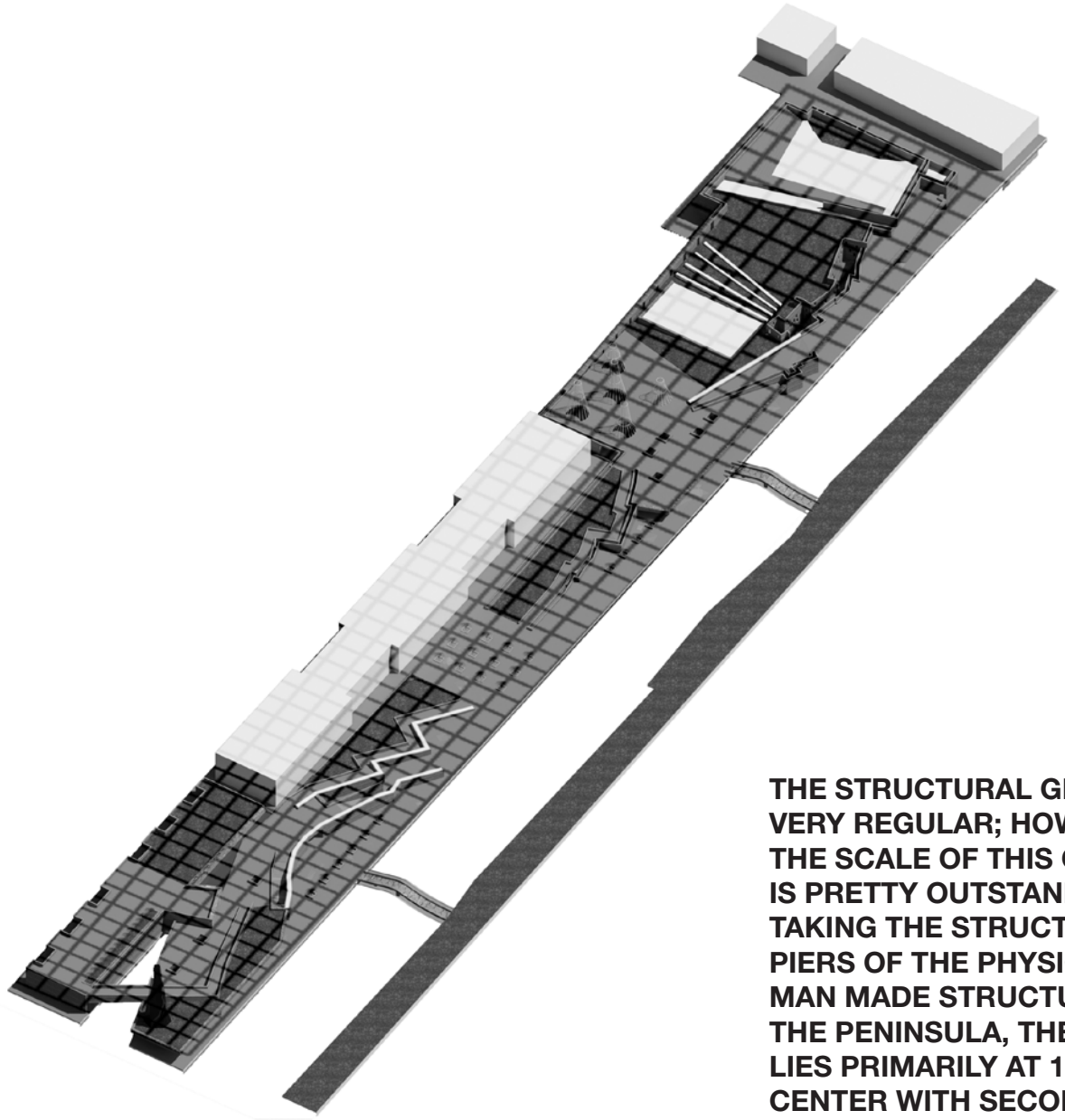
THE SUBTRACTION OF STRUCTURE WAS CRUCIAL IN ATTEMPTING TO BRING LIGHT INTO THE COVERED "UNDERGROUND" SPACES OF THE PROJECT. BY CARVING AWAY CERTAIN HARDSCAPE, SPECIAL EXPERIENCES IN SUB TERRAIN WERE ESTABLISHED.

LIGHTWELLS



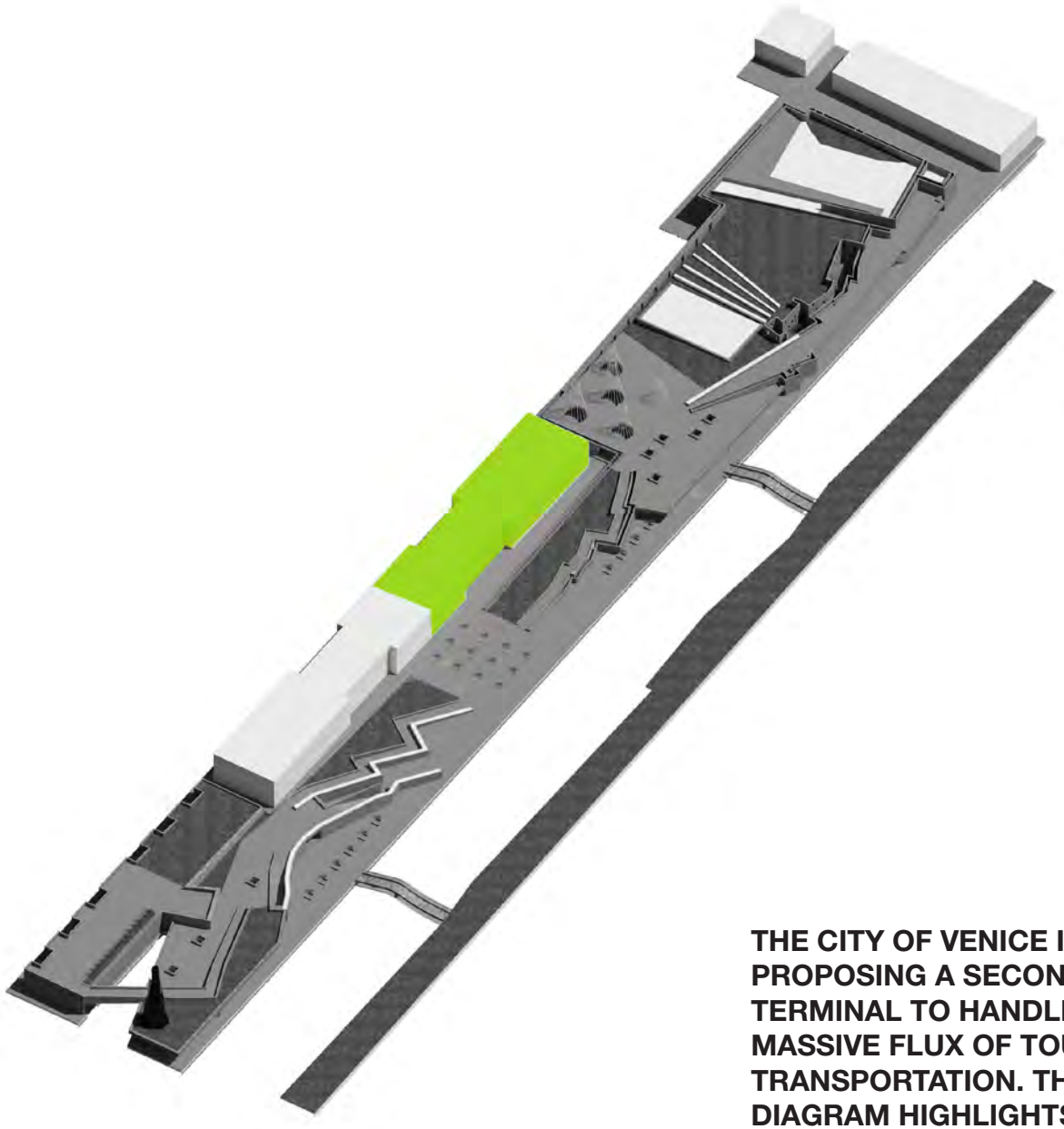
GREENSCAPE IS HIGHLIGHTED HERE AS AN ALTERNATE TO LANDSCAPE. THESE AREAS CAN BE OCCUPIED BY VISITORS OF THE SITE BOTH LEISURELY AND RECREATIONALLY.

GREENSCAPE



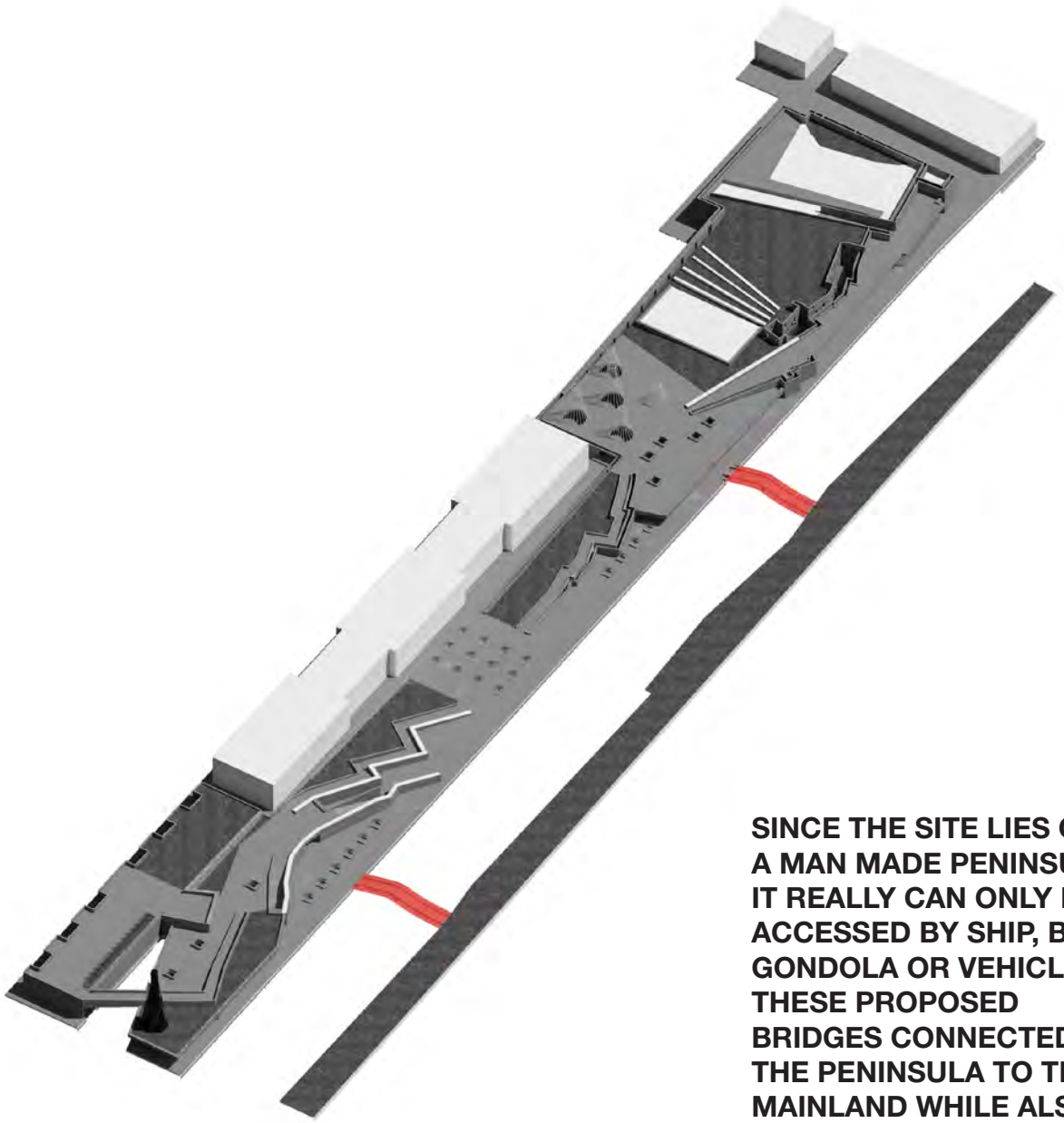
THE STRUCTURAL GRID IS VERY REGULAR; HOWEVER, THE SCALE OF THIS GRID IS PRETTY OUTSTANDING. TAKING THE STRUCTURAL PIERS OF THE PHYSICAL MAN MADE STRUCTURE OF THE PENINSULA, THE GRID LIES PRIMARILY AT 100’ ON CENTER WITH SECONDARY STRUCTURAL ELEMENTS LAID ON THE 20’X20’ GRID.

STRUCTURAL GRID



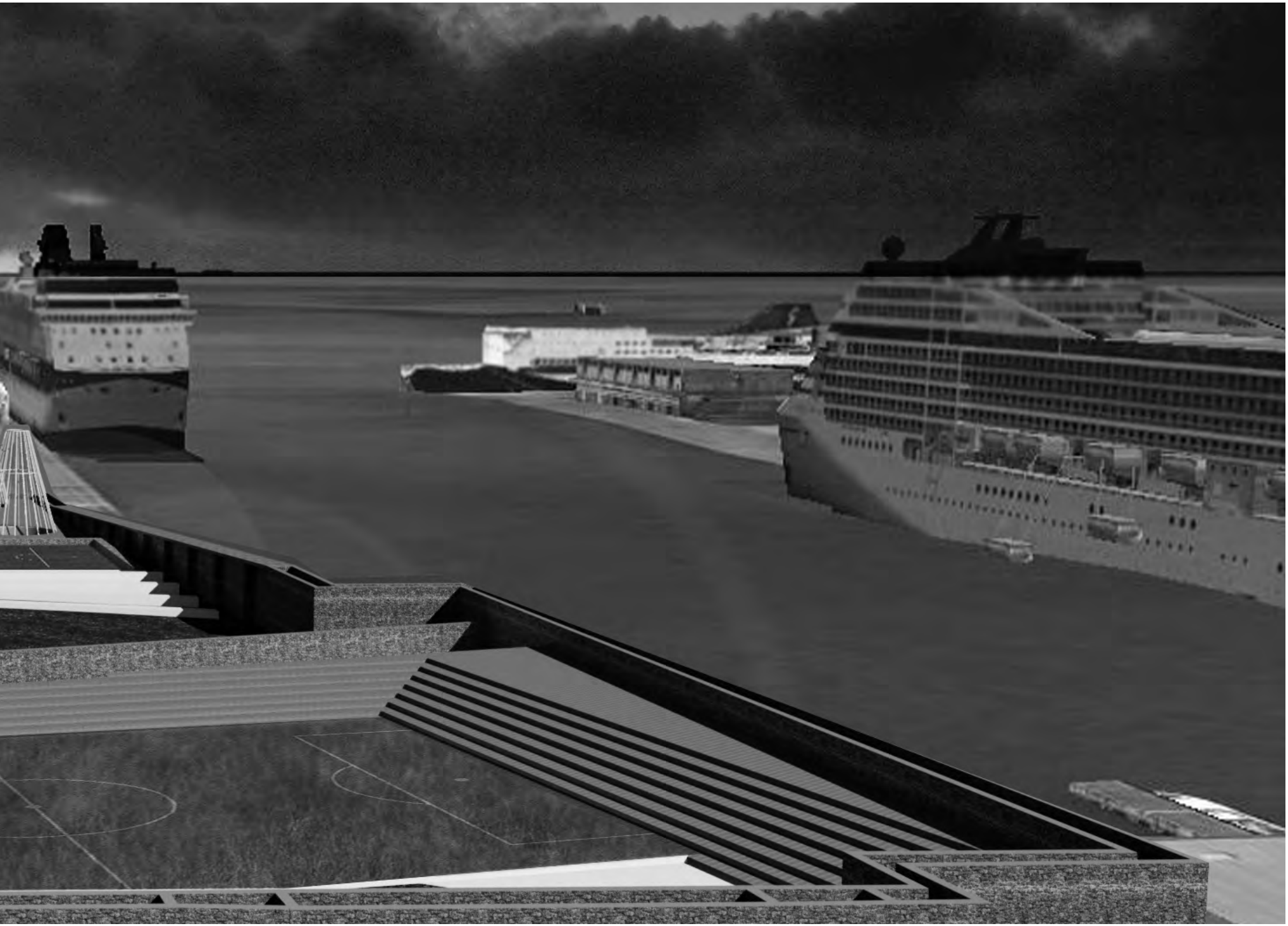
THE CITY OF VENICE IS PROPOSING A SECONDARY TERMINAL TO HANDLE THE MASSIVE FLUX OF TOURIST TRANSPORTATION. THIS DIAGRAM HIGHLIGHTS THE LOCATION OF SAID STRUCTURE.

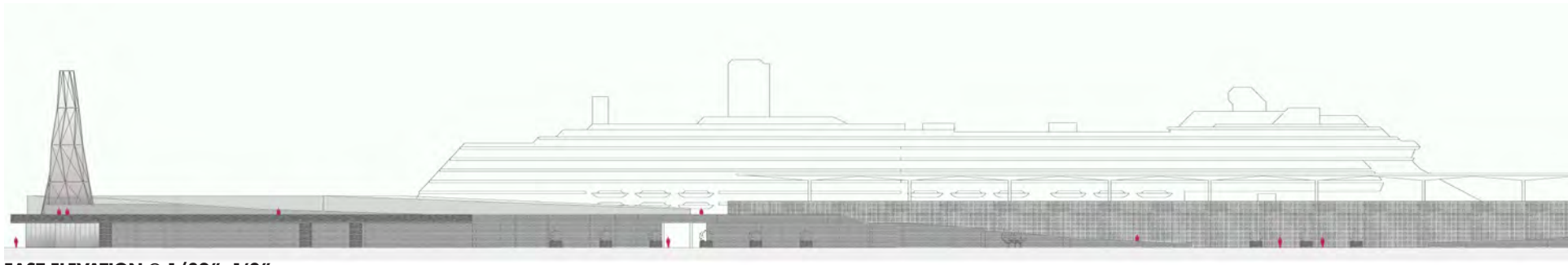
ADDITION



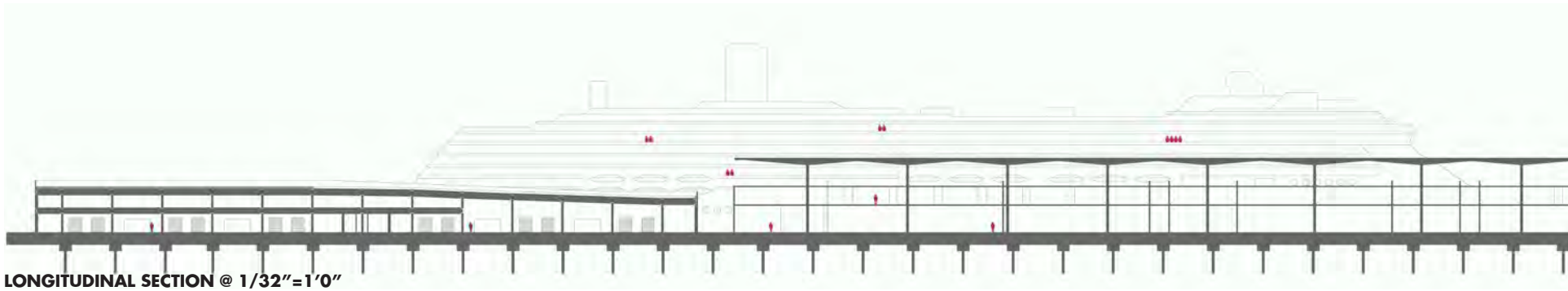
SINCE THE SITE LIES ON A MAN MADE PENINSULA, IT REALLY CAN ONLY BE ACCESSED BY SHIP, BOAT, GONDOLA OR VEHICLE. THESE PROPOSED BRIDGES CONNECTED THE PENINSULA TO THE MAINLAND WHILE ALSO ALLOWING WATER TRAFFIC TO PASS UNDERNEATH.

BRIDGING

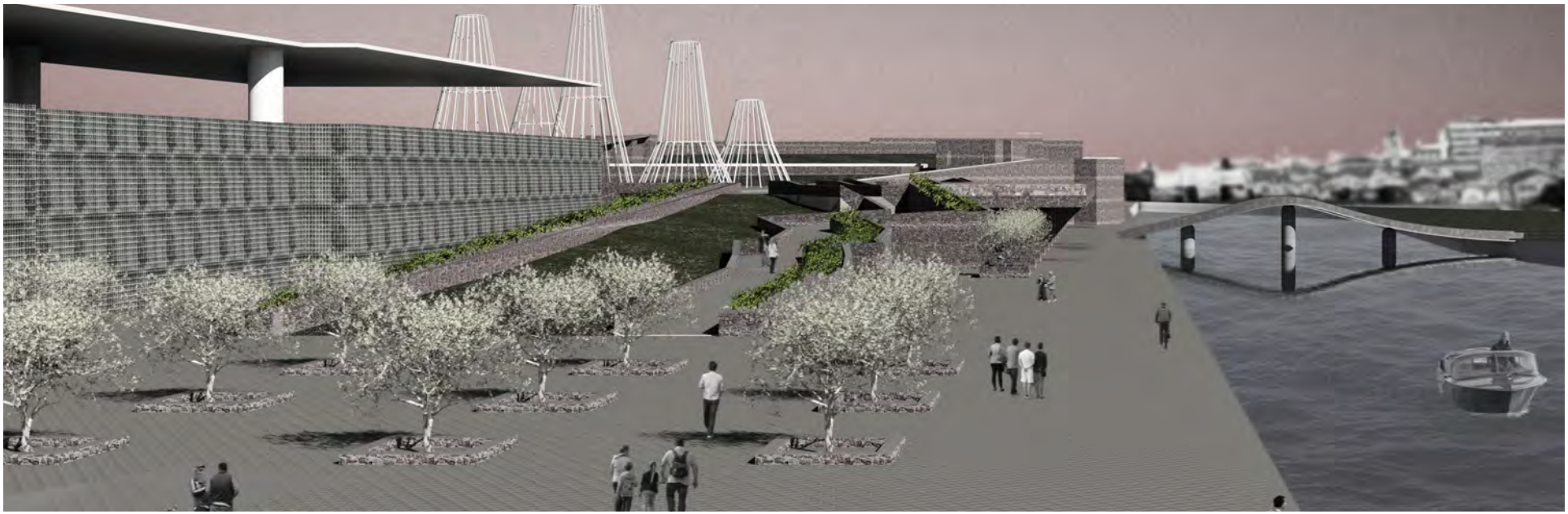


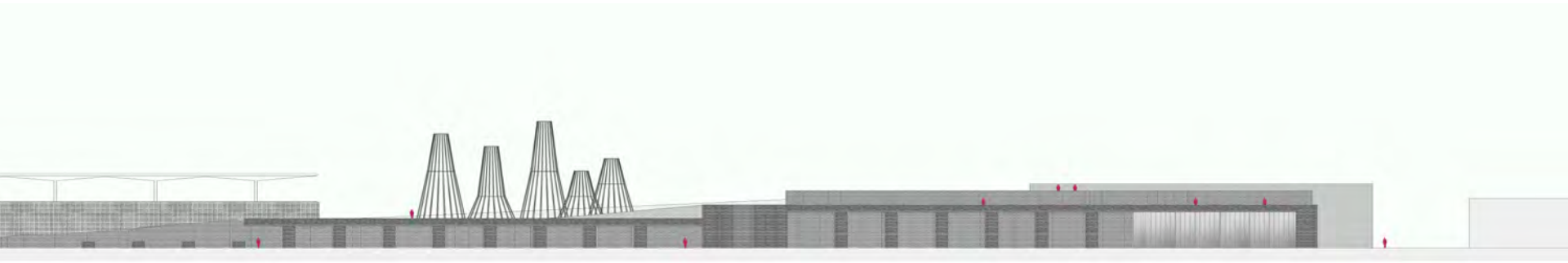


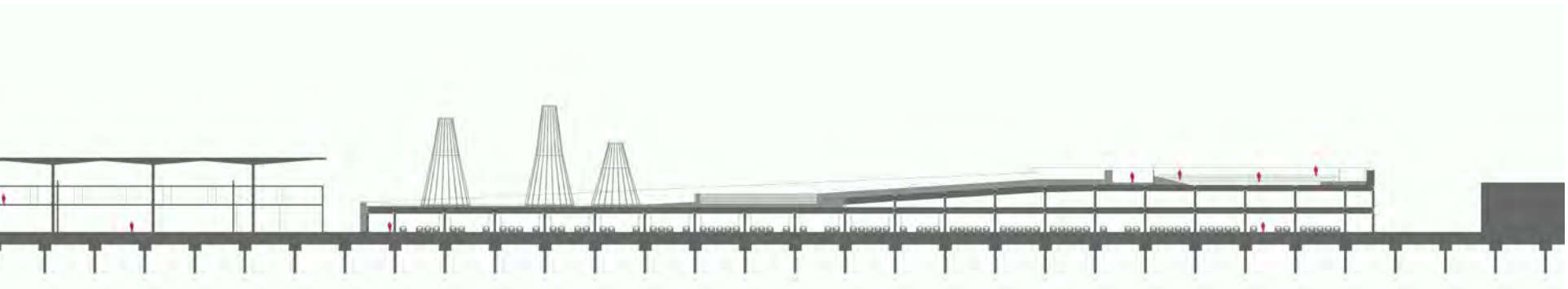
EAST ELEVATION @ 1/32″=1′0″

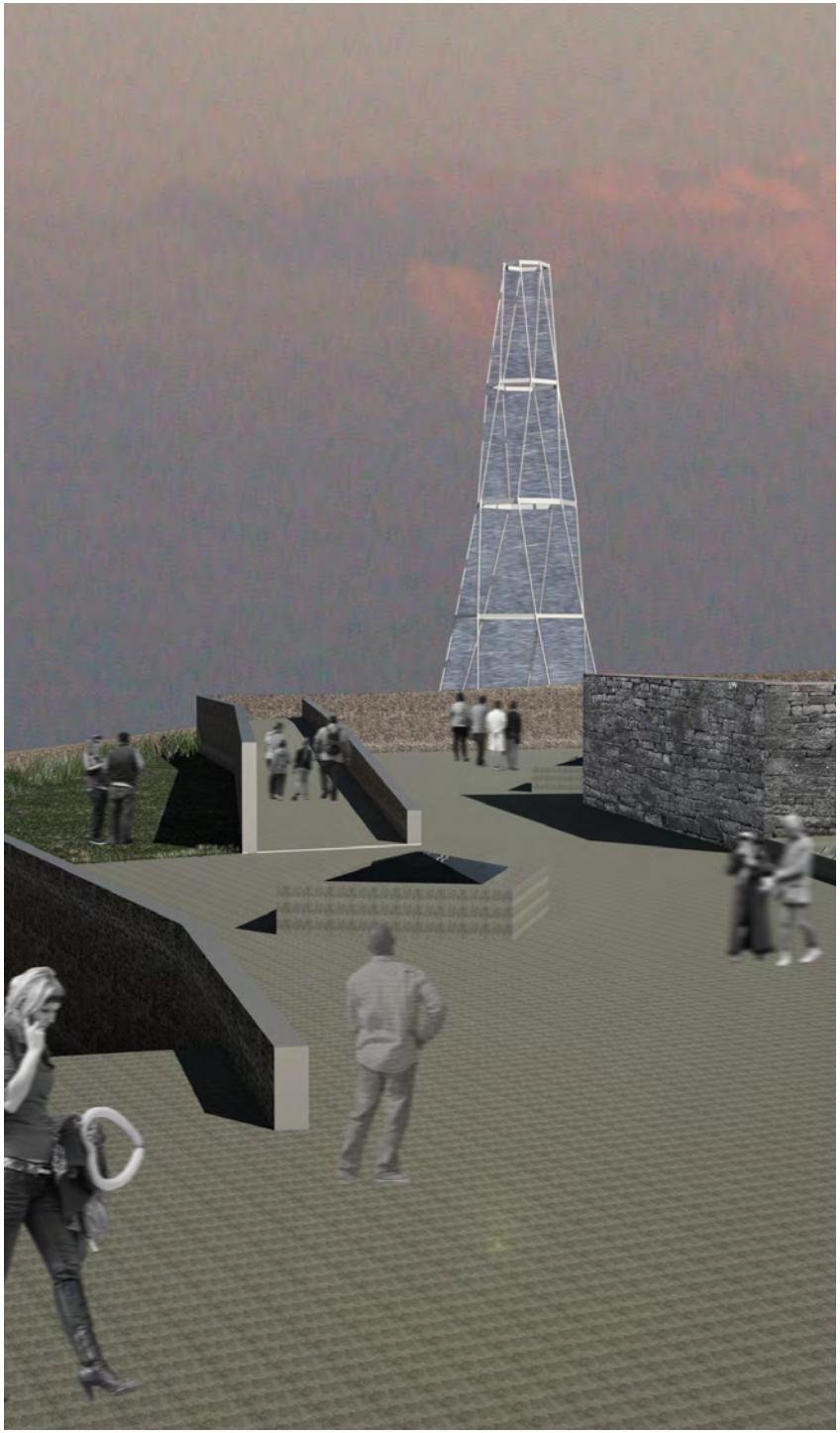


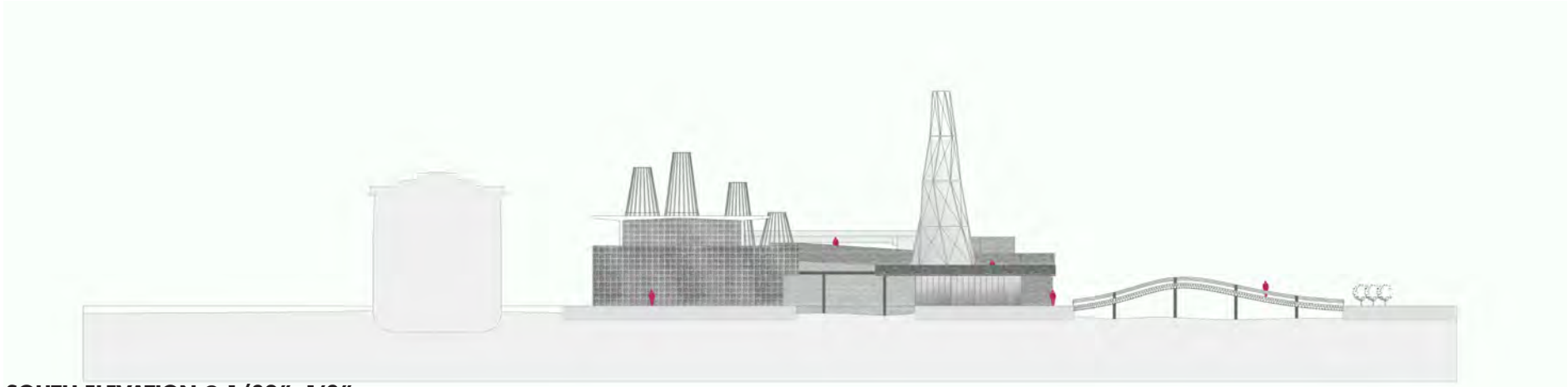
LONGITUDINAL SECTION @ 1/32″=1′0″



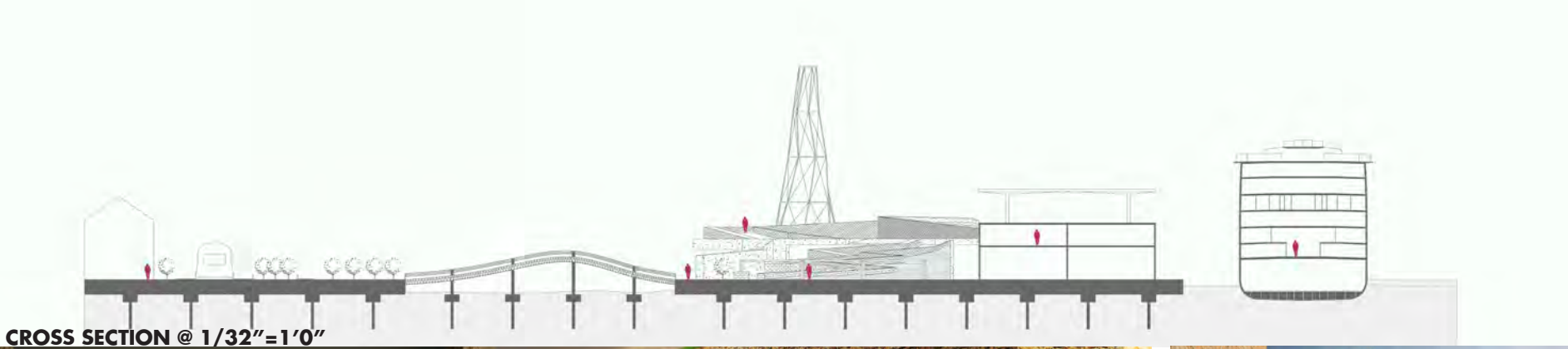




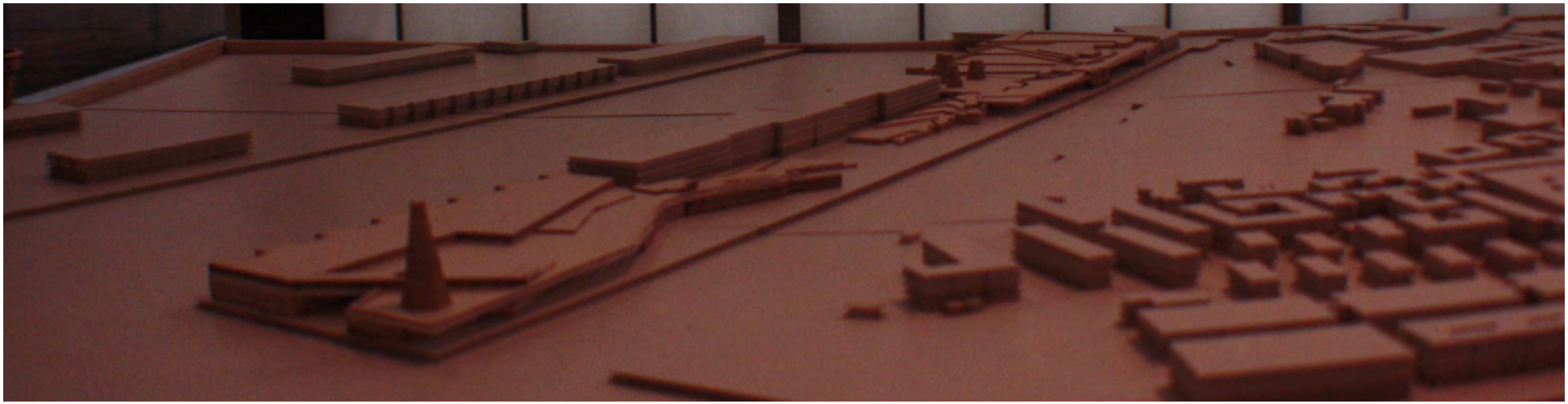




SOUTH ELEVATION @ 1/32″=1′0″



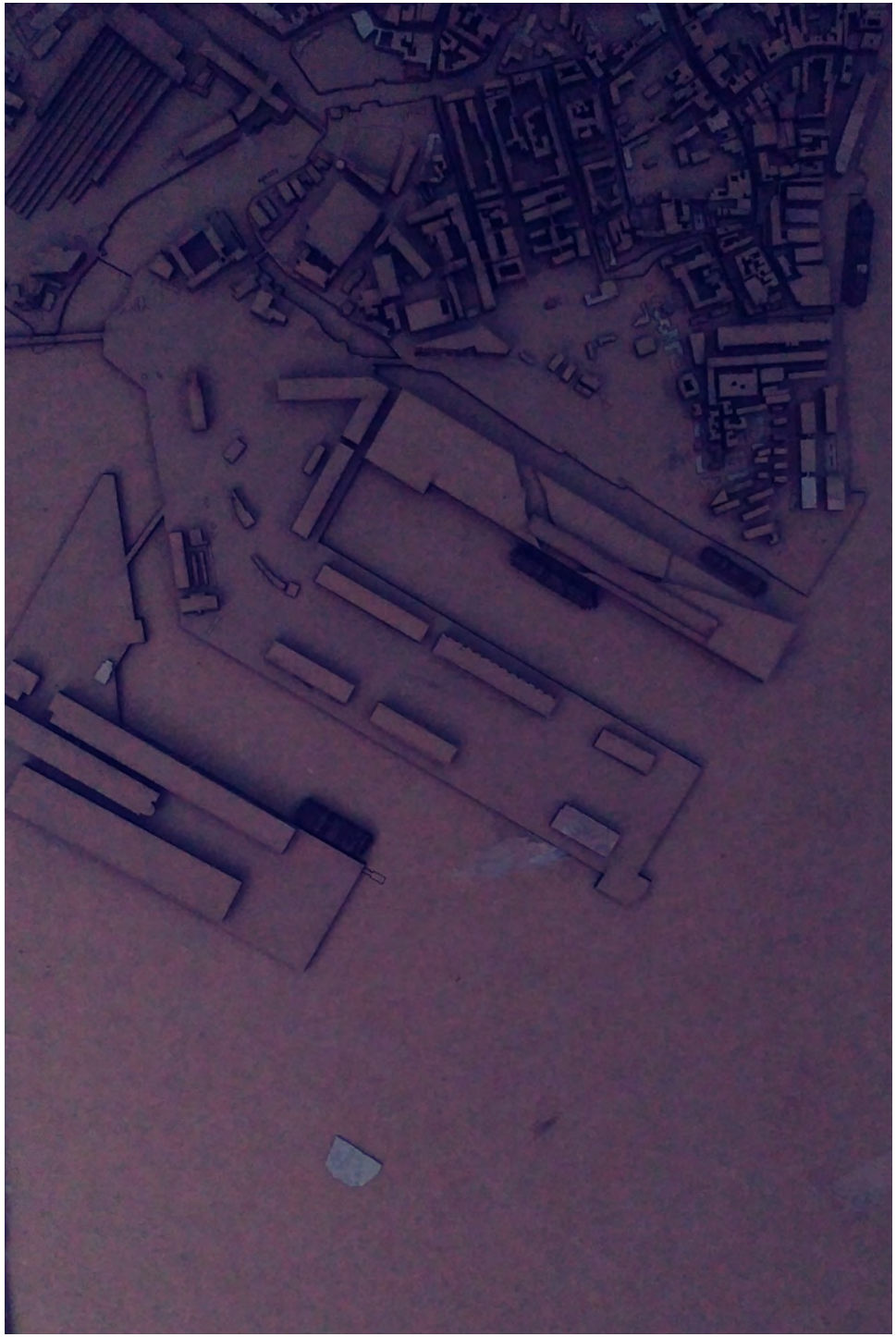
CROSS SECTION @ 1/32″=1′0″



V.

CONCEPTUAL FRAMEWORK

CLOSING THOUGHTS & ACKNOWLEDGEMENTS



FUTURE

GIVEN THE SCALE OF THE PROJECT, MANY ISSUES WERE NEVER RESOLVED. MOVING FORWARD, I THINK THIS PROJECT WARRANTS A FUTURE. IF I DO CHOSE TO CONTINUE TO WORK ON THIS PROJECT: DEVELOPING THE MAJOR SPACES, UNDERSTANDING THE TECHNOLOGIES OF THE WASTE TREATMENT CENTER AND FOLLIES, AND CONNECTING THE BUILDING TO VENICE IN MORE DIVERSE WAYS WOULD BE THE MAJOR CONCENTRATIONS AND CONCERNS TO BE RECONFIGURED.

THANKS

FIRST AND FOREMOST, I WOULD LIKE TO THANK MY PROFESSORS' ANDREW COHEN AND HASAN UDDIN-KHAN FOR THEIR SUPPORT THROUGHOUT SEMESTER, HELPING ME RESOLVE THE MYRIAD OF ISSUES MY PROJECT ENCOUNTERED ACROSS THE ENTIRETY OF IT'S DESIGN PROCESS. THE UTMOST GRATITUDE GOES OUT TO DJ ALEXANDER, FOR HIS TRUST AND PATIENCE WITH ME USING THE FACILITIES (CUTTING MODELS). THANK YOU TO MY FELLOW PEERS, THE PAST 6 YEARS HAS BEEN LEADING TO THIS MOMENT AND THANK YOU TO MY PARENTS, FOR THEIR CONSTANT SUPPORT THROUGHOUT MY TIME AT ROGER WILLIAMS UNIVERSITY.

6.

RULES AND REGULATIONS

COMUNE DI VENEZIA

Specifiche sul tema del rischio idrogeologico

Tavola

2 5

Scala

1:10.000

COMMISSARIO STRAORDINARIO
Vittorio Zappalorto

SUB COMMISSARIO PREFETTIZIO CON DELEGA ALL'URBANISTICA
Michele Sciacovelli

DIREZIONE SVILUPPO DEL TERRITORIO
Direttore: Cesar Cordio

Gruppo di progettazione:

Gabriele Archangeli
Marco Gordio
Gabriella Carletto
Elena Pavan
Angela Pappo
Cecilia Rossetto
Paola Tessari Lughezzi

Servizio GIT
Kelly Silvagni

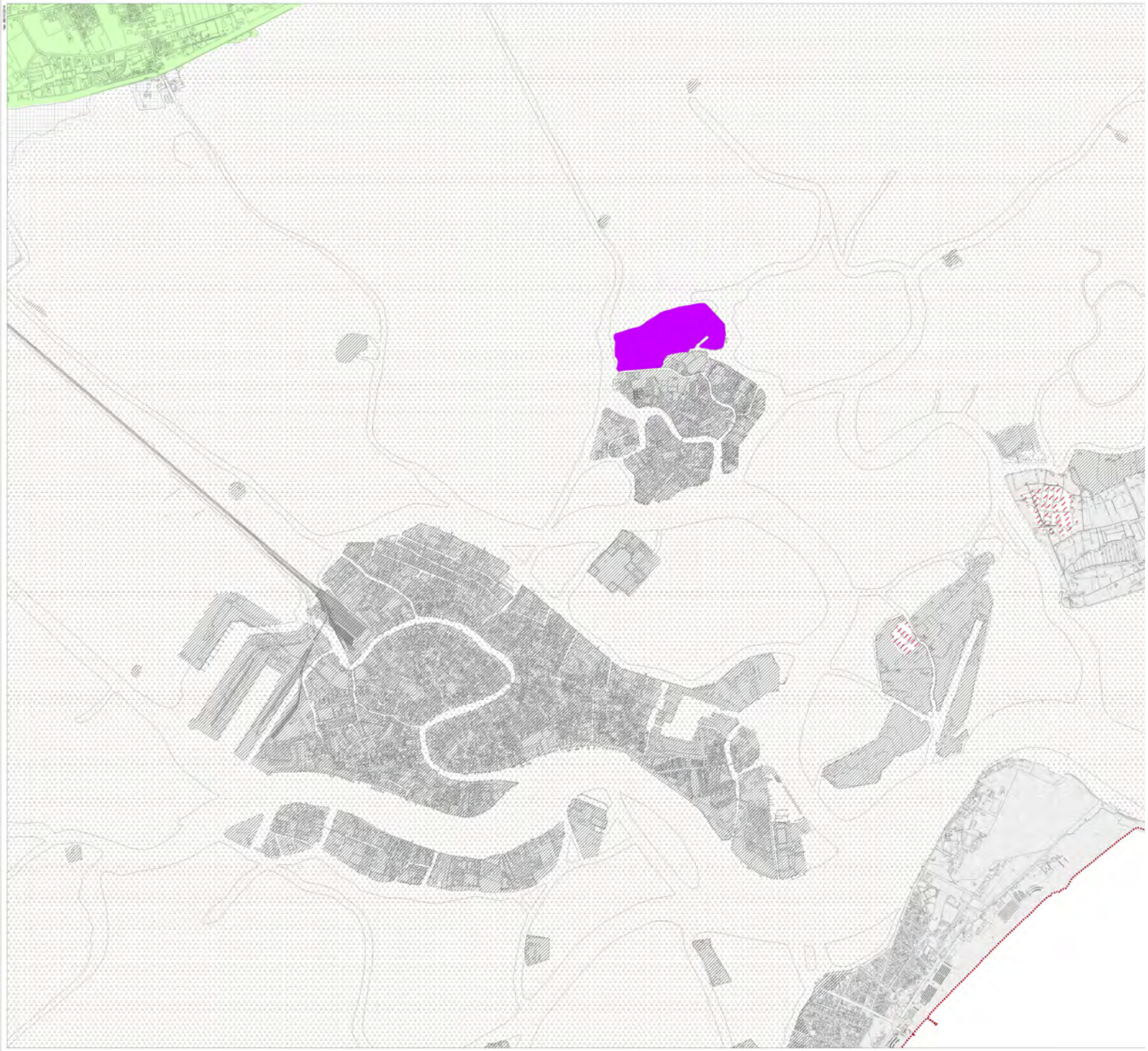
Delibera del Commissario Straordinario nella competenza del Consiglio Comunale
n° ..... del .....

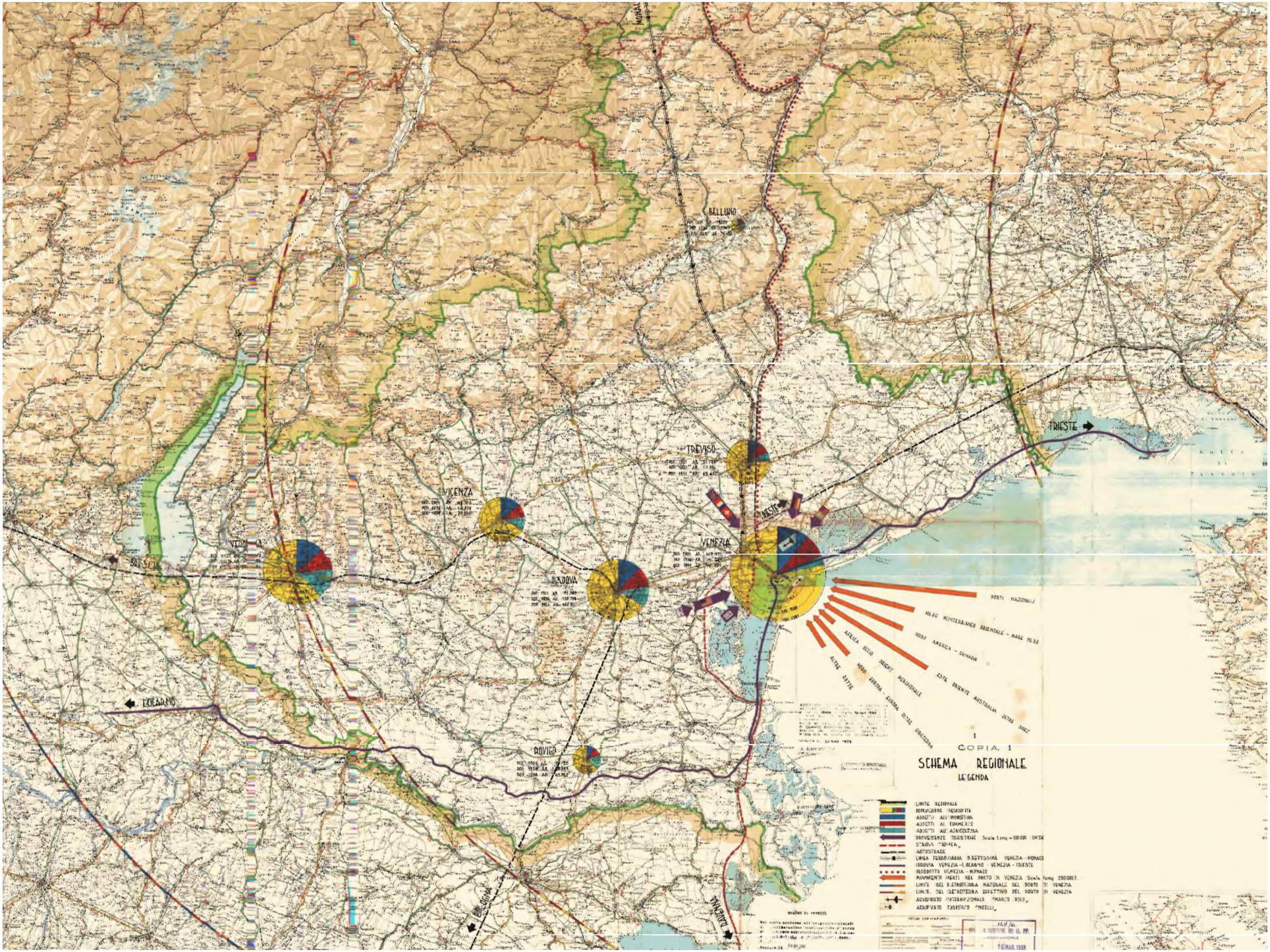
LEGENDA

Confini comunali

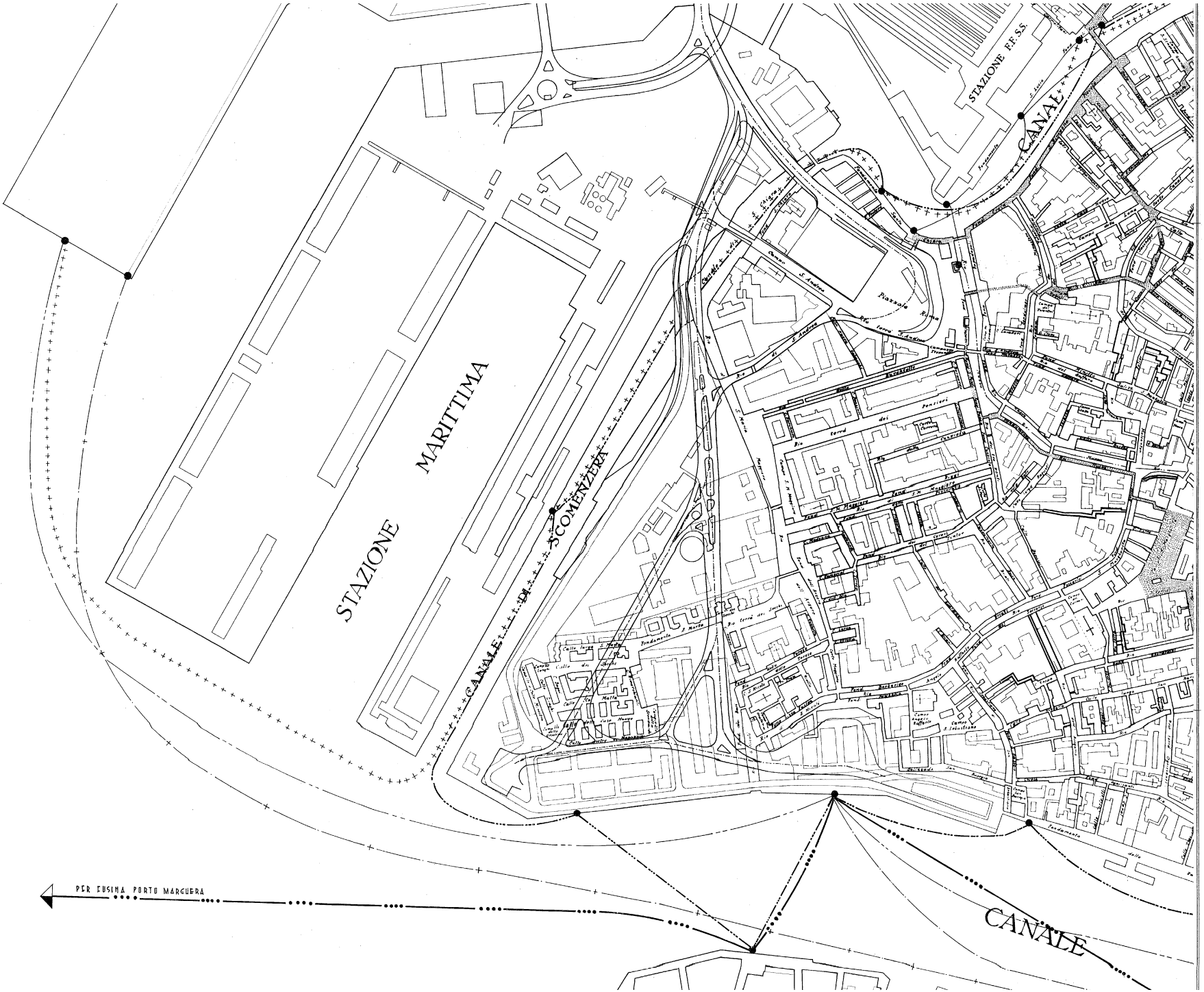
Compatibilità geologica	N.T.del PAT
Aree idonee	Art. 15
Aree idonee a condizione A (Sito di Interesse Nazionale e Aeroporto)	Art. 15
Aree idonee a condizione B (Centro storico e Isole della Laguna)	Art. 15
Aree idonee a condizione C (Area lagunare sommersa comprese barene, velme, canali lagunari)	Art. 15
Aree idonee a condizione D (Aree litorali e isole emerse)	Art. 15
Aree idonee a condizione E (Aree con caratteristiche geotecniche scadenti)	Art. 15
Aree idonee a condizione F (Aree con corpi idrici ricettori a rischio idraulico)	Art. 15
Aree idonee a condizione G (Aree con corpi idrici ricettori in trasformazione - Progetto Moranzani -)	Art. 15
Aree idonee a condizione H (Aree di discarica non attiva)	Art. 15
Aree non idonee (Aree di discarica attiva)	Art. 15

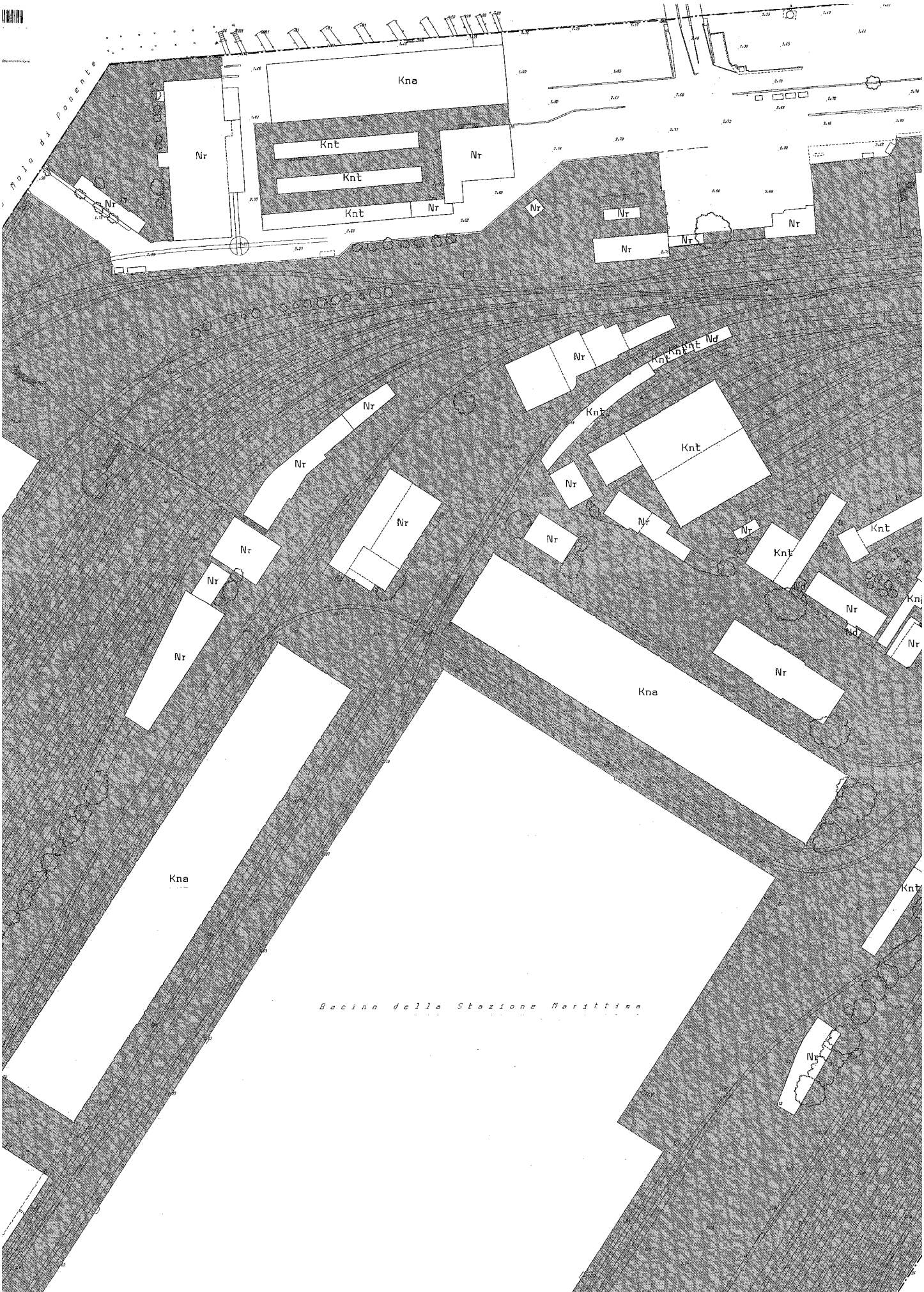
Aree a dissesto idrogeologico	
Aree esondabili o a ristagno idrico (per insufficienza della rete strutturale fognaria e di bonifica)	Art. 16
Aree esondabili o a ristagno idrico (durante eventi di mareggiata)	Art. 16
Aree esondabili o a ristagno idrico (durante eventi di alta marea)	Art. 16




BELLUNO
TREVISO
TRIESTE
VICENZA
VERONA
PADOVA
VENEZIA
ROVIGO
COPIA 1
SCHEMA REGIONALE
LEGENDA


COMUNE DI VENEZIA
PIANO REGOLATORE GENERALE
ZONIZZAZIONE E VIABILITA'
VENEZIA STORICA
SCALA 1:2000
LEGENDA
OSPEDALE
(P.P.P.)
GRANDE
CANAL
STAZIONE MARITTIMA
ZACCARIA
(Progetto)
CANALE
DELLA
GIUDECCA
BACINO
SAN
MARCO
(P.P.P.)
GIUDECCA


STAZIONE MARITTIMA
STAZIONE F.F.S.S.
CANALE
SCOMENZERA
CANALE
CANALE
PER LUSINA PORTO MARGHERA


Kna
Knt
Knt
Knt
Nr
Nr
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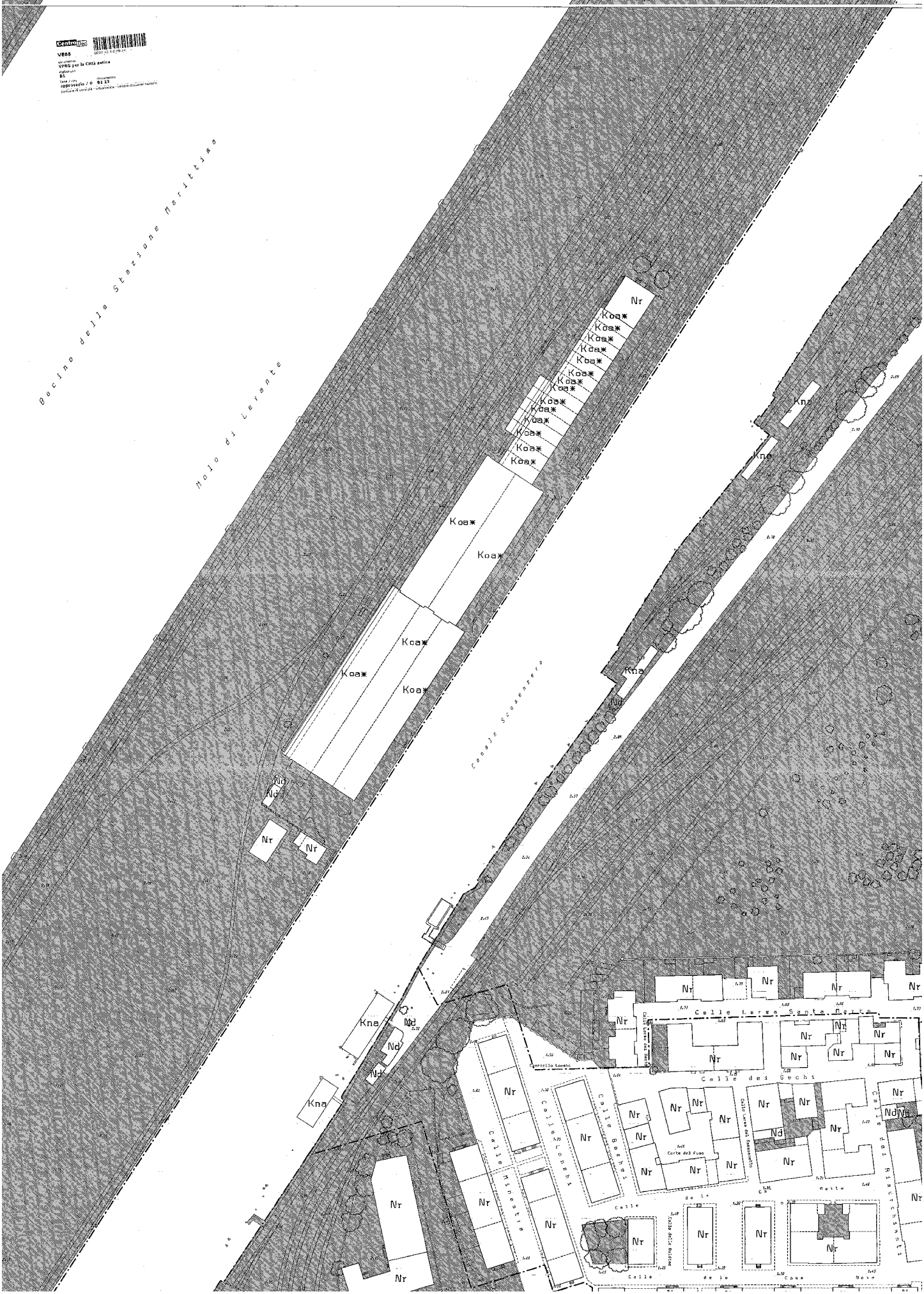

Bacino della Stazione Marittima
Molo di Levante
Canale Scomenzera
Koa*
Kna
Nr
Nd
Calle dei Sechi
Calle Minelle
Calle Bonelli
Corte dei Fuoi

CHAPTER 4

SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

SECTION 401
SCOPE

401.1 Detailed use and occupancy requirements. In addition to the occupancy and construction requirements in this code, the provisions of this chapter apply to the special uses and occupancies described herein.

SECTION 402
COVERED MALL AND OPEN MALL BUILDINGS

402.1 Scope. The provisions of this section shall apply to buildings or structures defined herein as *covered mall buildings* not exceeding three floor levels at any point nor more than three *stories above grade plane.* Except as specifically required by this section, *covered mall bUildings* shall meet applicable provisions of this code.

Exceptions:

1. Foyers and lobbies of Groups B, R-1 and R-2 are not required to comply with this section.
2. Buildings need not comply with the provisions of this section when they totally comply with other applicable provisions of this code.

402.2 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

ANCHOR BUILDING. An exterior perimeter building of a group other than H having direct access to a *covered mall building* but having required *means of egress* independent of the mall.

COVERED MALL BUILDING. A single building enclosing a number of tenants and occupants, such as retail stores, drinking and dining establishments, entertainment and amusement facilities, passenger transportation terminals, offices and other similar uses wherein two or more tenants have a main entrance into one or more malls. For the purpose of this chapter, *anchor buildings* shall not be considered as a part of the *covered mall building.* The term "*covered mall building*" shall include open mall buildings as defined below.

Mall. A roofed or covered common pedestrian area within a *covered mall bUilding* that serves as access for two or more tenants and not to exceed three levels that are open to each other. The term "mall" shall include open malls as defined below.

Open mall. An unroofed common pedestrian way serving a number of tenants not exceeding three levels. Circulation at levels above grade shall be permitted to include open exterior balconies leading to *exits* discharging at grade.

Open mall building. Several structures housing a number of tenants, such as retail stores, drinking and dining establishments, entertainment and amusement facilities, offices, and other similar uses, wherein two or more tenants have a main entrance into one or more open malls. For the purpose of Chapter 4 of the *International Building Code, anchor bUildings* are not considered as a part of the open mall building.

FOOD COURT. A public seating area located in the mall that serves adjacent food preparation tenant spaces.

GROSS LEASABLE AREA. The total floor area designed for tenant occupancy and exclusive use. The area of tenant occupancy is measured from the centerlines of joint partitions to the outside of the tenant walls. All tenant areas, including areas used for storage, shall be included in calculating gross leasable area.

402.3 Lease plan. Each *covered mall bUilding* owner shall provide both the building and fire departments with a lease plan showing the location of each occupancy and its exits after the certificate of occupancy has been issued. No modifications or changes in occupancy or use shall be made from that shown on the lease plan without prior approval of the *building official.*

402.4 Means of egress. Each tenant space and the *covered mall bUilding* shall be provided with *means of egress* as required by this section and this code. Where there is a conflict between the requirements of this code and the requirements of this section, the requirements of this section shall apply.

402.4.1 Determination of occupant load. The *occupant load* permitted in any individual tenant space in a *covered mall building* shall be determined as required by this code. *Means of egress* requirements for individual tenant spaces shall be based on the *occupant load* thus determined.

402.4.1.1 Occupant formula. In determining required *means of egress* of the mall, the number of occupants for whom *means of egress* are to be provided shall be based on gross leasable area of the *covered mall building* (excluding *anchor bUildings)* and the *occupant load factor* as determined by the following equation.

$$aLP = (0.00007)\ (CLA) + 25 \qquad \text{(Equation 4-1)}$$

where:

aLP = The *occupant load* factor (square feet per person).

CLA = The gross leasable area (square feet).

Exception: Tenant spaces attached to a *covered mall building* but with a *means of egress* system that is totally independent of the *covered mall bUilding* shall not be considered as gross leasable area for determining the required *means of egress* for the *covered mall bUilding.*

402.4.1.2 OLF range. The *occupant load* factor *(OLE)* is not required to be less than 30 and shall not exceed 50.

402.4.1.3 Anchor buildings. The *occupant load* of *anchor bUildings* opening into the mall shall not be included in computing the total number of occupants for the mall.

402.4.1.4 Food courts. The *occupant load* of a food court shall be determined in accordance with Section 1004. For the purposes of determining the *means of egress* requirements for the mall, the food court *occupant load* shall be added to the *occupant load* of the *covered mall bUilding* as calculated above.

402.4.2 Number of means of egress. Wherever the distance of travel to the mall from any location within a tenant space used by persons other than employees exceeds 75 feet (22 860 mm) or the tenant space has an *occupant load* of 50 or more, not less than two *means of egress* shall be provided.

402.4.3 Arrangements of means of egress. Assembly occupancies with an *occupant load* of 500 or more shall be so located in the *covered mall bUilding* that their entrance will be immediately adjacent to a principal entrance to the mall and shall have not less than one-half of their required *means of egress* opening directly to the exterior of the *covered mall building.*

402.4.3.1 Anchor building means of egress. Required *means of egress* for *anchor bUildings* shall be provided independently from the mall *means of egress* system. The *occupant load* of *anchor bUildings* opening into the mall shall not be included in determining *means of egress* requirements for the mall. The path of egress travel of malls shall not exit through anchor buildings. Malls terminating at an *anchor building* where no other *means of egress* has been provided shall be considered as a dead-end mall.

402.4.4 Distance to exits. Within each individual tenant space in a *covered mall bUilding,* the maximum distance of travel from any point to an *exit* or entrance to the mall shall not exceed 200 feet (60 960 mm).

The maximum distance of travel from any point within a mall to an *exit* shall not exceed 200 feet (60 960 mm).

402.4.5 Access to exits. Where more than one *exit* is required, they shall be so arranged that it is possible to travel in either direction from any point in a mall to separate *exits.* The minimum width of an *exit passageway* or *corridor from* a mall shall be 66 inches (1676 mm).

Exception: Dead ends not exceeding a length equal to twice the width of the mall measured at the narrowest location within the dead-end portion of the mall.

402.4.5.1 Exit passageways. Where *exit passageways* provide a secondary *means of egress* from a tenant space, doorways to the *exit passageway* shall be protected by I-hour *fire door assemblies* that are self- or automatic-closing by smoke detection in accordance with Section 715.4.8.3.

402.4.6 Service areas fronting on exit passageways. Mechanical rooms, electrical rooms, building service areas and service elevators are permitted to open directly into *exit passageways,* provided the *exit passageway* is separated from such rooms with not less than I-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both. The minimum *fire protection rating* of openings in the *fire barriers* shall be 1 hour.

402.5 Mall width. For the purpose of providing required egress, malls are permitted to be considered as *corridors* but need not comply with the requirements of Section 1005.1 of this code where the width of the mall is as specified in this section.

402.5.1 Minimum width. The minimum width of the mall shall be 20 feet (6096 mm). The mall width shall be sufficient to accommodate the *occupant load served.* There shall be a minimum of 10 feet (3048 mm) clear exit width to a height of 8 feet (2438 mm) between any projection of a tenant space bordering the mall and the nearest kiosk, vending machine, bench, display opening, food court or other obstruction to *means of egress* travel.

402.5.2 Minimum width open mall. The minimum floor and roof opening width above grade shall be 20 feet (9096 mm) in open malls.

402.6 Types of construction. The area of any *covered mall building,* including *anchor buildings,* of Types I, II, III and IV construction, shall not be limited provided the *covered mall bUilding* and attached *anchor bUildings* and parking garages are surrounded on all sides by a permanent open space of not less than 60 feet (18 288 mm) and the *anchor bUildings* do not exceed three *stories above grade plane.* The allowable height and area of *anchor bUildings* greater than three *stories above grade plane* shall comply with Section 503, as modified by Sections 504 and 506. The construction type of *open parking garages* and enclosed parking garages shall comply with Sections 406.3 and 406.4, respectively.

402.6.1 Reduced open space. The permanent open space of 60 feet (18 288 mm) shall be permitted to be reduced to not less than 40 feet (12 192 mm), provided the following requirements are met:

1. The reduced open space shall not be allowed for more than 75 percent of the perimeter of the *covered mall building* and *anchor buildings.*
2. The *exterior wall* facing the reduced open space shall have a minimum *fire-resistance rating* of 3 hours.
3. Openings in the *exterior wall* facing the reduced open space shall have opening protectives with a minimum *fire protection rating* of 3 hours.
4. Group E, H, I or R occupancies are not within the *covered mall building* or *anchor stores.*

402.7 Fire-resistance-rated separation. Fire-resistance-rated separation is not required between tenant spaces and the mall. Fire-resistance-rated separation is not required between a food court and adjacent tenant spaces or the mall.

402.7.1 Attached garage. An attached garage for the storage of passenger vehicles having a capacity of not more than

nine persons and *open parking garages* shall be considered as a separate building where it is separated from the *covered mall bUilding* by not less than 2-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both.

Exception: Where an *open parking garage* or enclosed parking garage is separated from the *covered mall building* or *anchor building* a distance greater than 10 feet (3048 mm), the provisions of Table 602 shall apply. Pedestrian walkways and tunnels that attach the *open parking garage* or enclosed parking garage to the *covered mall bUilding* or *anchor bUilding* shall be constructed in accordance with Section 3104.

402.7.2 Tenant separations. Each tenant space shall be separated from other tenant spaces by a *fire partition* complying with Section 709. A tenant separation wall is not required between any tenant space and the mall.

402.7.3 Anchor building separation. An *anchor bUilding* shall be separated from the *covered mall bUilding* by *fire walls* complying with Section 706.

Exception: *Anchor bUildings* of not more than three *stories above grade plane* that have an occupancy classification the same as that permitted for tenants of the *covered mall building* shall be separated by 2-hour fire-resistive *fire barriers* complying with Section 707.

402.7.3.1 Openings between anchor building and mall. Except for the separation between Group R-l *sleeping units* and the mall, openings between *anchor bUildings* of Type lA, IB, IIA and IIB construction and the mall need not be protected.

402.8 Interior finish. *Interior wall* and *ceiling finishes* within the mall and *exits* shall have a minimum *flame spread index* and smoke-developed index of Class B in accordance with Chapter *8. Interior floor finishes* shall meet the requirements of Section 804.

[F] 402.9 Automatic sprinkler system. The *covered mall bUilding* and buildings connected shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, which shall comply with the following:

1. The *automatic sprinkler system* shall be complete and operative throughout occupied space in the *covered mall building* prior to occupancy of any of the tenant spaces. Unoccupied tenant spaces shall be similarly protected unless provided with *approved* alternative protection.
2. Sprinkler protection for the mall shall be independent from that provided for tenant spaces or anchors. Where tenant spaces are supplied by the same system, they shall be independently controlled.

Exception: An *automatic sprinkler system* shall not be required in spaces or areas of *open parking garages* constructed in accordance with Section 406.3.

[F] 402.9.1 Standpipe system. The *covered mall bUilding* shall be equipped throughout with a standpipe system as required by Section 905.3.3.

402.10 Smoke control. Where a *covered mall building* contains an atrium, a smoke control system shall be provided in accordance with Section 404.5.

Exception: A smoke control system is not required in *covered mall bUildings* when an atrium connects only two stories.

402.11 Kiosks. Kiosks and similar structures (temporary or permanent) shall meet the following requirements:

1. Combustible kiosks or other structures shall not be located within the mall unless constructed of any of the following materials:
   1.1. *Fire-retardant-treated wood* complying with Section 2303.2.
   1.2. Foam plastics having a maximum heat-release rate not greater than 100 kilowatts (105 Btu/h) when tested in accordance with the exhibit booth protocol in UL 1975.
   1.3. Aluminum composite material (ACM) having a *flame spread index* of not more than 25 and a smoke-developed index of not more than 450 when tested as an assembly in the maximum thickness intended for use in accordance with ASTM E 84 or UL 723.
2. Kiosks or similar structures located within the mall shall be provided with *approved* fire suppression detection devices.
3. The minimum horizontal separation between kiosks or groupings thereof and other structures within the mall shall be 20 feet (6096 mm).
4. Each kiosk or similar structure or groupings thereof shall have a maximum area of 300 square feet (28 m^2).

402.12 Children's playground structures. Structures intended as children's playgrounds that exceed 10 feet (3048 mm) in height and 150 square feet (14 m^2) in area shall comply with Sections 402.12.1 through 402.12.4.

402.12.1 Materials. Children's playground structures shall be constructed of noncombustible materials or of combustible materials that comply with the following:

1. *Fire-retardant-treated wood.*
2. Light-transmitting plastics complying with Section 2606.
3. Foam plastics (including the pipe foam used in soft-contained play equipment structures) having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with UL 1975.
4. Aluminum composite material (ACM) meeting the requirements of Class A *interior finish* in accordance with Chapter 8 when tested as an assembly in the maximum thickness intended for use.
5. Textiles and films complying with the flame propagation performance criteria contained in NFPA 701.
6. Plastic materials used to construct rigid components of soft-contained play equipment structures (such as tubes, windows, panels, junction boxes, pipes, slides

and decks) exhibiting a peak rate of heat release not exceeding 400 kW/m^2 when tested in accordance with ASTM E 1354 at an incident heat flux of 50 kW/m^2 in the horizontal orientation at a thickness of 6 mm.

7. Ball pool balls, used in soft-contained play equipment structures, having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with UL 1975. The minimum specimen test size shall be 36 inches by 36 inches (914 mm by 914 mm) by an average of 21 inches (533 mm) deep, and the balls shall be held in a box constructed of galvanized steel poultry netting wire mesh.
8. Foam plastics shall be covered by a fabric, coating or film meeting the flame propagation performance criteria of NFPA 701.
9. The floor covering placed under the children's playground structure shall exhibit a Class I *interior floor finish* classification, as described in Section 804, when tested in accordance with NFPA 253.

402.12.2 Fire protection. Children's playground structures located within the mall shall be provided with the same level of *approved* fire suppression and detection devices required for kiosks and similar structures.

402.12.3 Separation. Children's playground structures shall have a minimum horizontal separation from other structures within the mall of 20 feet (6090 mm).

402.12.4 Area limits. Children's playground structures shall not exceed 300 square feet (28 m^2) in area, unless a special investigation has demonstrated adequate fire safety.

402.13 Security grilles and doors. Horizontal sliding or vertical security grilles or doors that are a part of a required *means of egress* shall conform to the following:

1. They shall remain in the full open position during the period of occupancy by the general public.
2. Doors or grilles shall not be brought to the closed position when there are 10 or more persons occupying spaces served by a single exit or 50 or more persons occupying spaces served by more than one exit.
3. The doors or grilles shall be openable from within without the use of any special knowledge or effort where the space is occupied.
4. Where two or more exits are required, not more than one-half of the exits shall be permitted to include either a horizontal sliding or vertical rolling grille or door.

[F] 402.14 Standby power. *Covered mall bUildings* exceeding 50,000 square feet (4645 m^2) shall be provided with standby power systems that are capable of operating the emergency voice/alarm communication system.

[F] 402.15 Emergency voice/alarm communication system. *Covered mall buildings* exceeding 50,000 square feet (4645 m^2) in total floor area shall be provided with an emergency voice/alarm communication system. Emergency voice/alarm communication systems serving a mall, required or otherwise, shall be accessible to the fire department. The system shall be provided in accordance with Section 907.5.2.2.

402.16 Plastic signs. Plastic signs affixed to the storefront of any tenant space facing the mall shall be limited as specified in Sections 402.16.1 through 402.16.5.2.

402.16.1 Area. Plastic signs shall not exceed 20 percent of the wall area facing the mall.

402.16.2 Height and width. Plastic signs shall not exceed a height of 36 inches (914 mm), except that if the sign is vertical, the height shall not exceed 96 inches (2438 mm) and the width shall not exceed 36 inches (914 mm).

402.16.3 Location. Plastic signs shall be located a minimum distance of 18 inches (457 mm) from adjacent tenants.

402.16.4 Plastics other than foam plastics. Plastics other than foam plastics used in signs shall be light-transmitting plastics complying with Section 2606.4 or shall have a self-ignition temperature of 650°F (343°C) or greater when tested in accordance with ASTM D 1929, and a *flame spread index* not greater than 75 and smoke-developed index not greater than 450 when tested in the manner intended for use in accordance with ASTM E 84 or UL 723 or meet the acceptance criteria of Section 803.1.2.1 when tested in accordance with NFPA 286.

402.16.4.1 Encasement. Edges and backs of plastic signs in the mall shall be fully encased in metal.

402.16.5 Foam plastics. Foam plastics used in signs shall have flame-retardant characteristics such that the sign has a maximum heat-release rate of 150 kilowatts when tested in accordance with UL 1975 and the foam plastics shall have the physical characteristics specified in this section. Foam plastics used in signs installed in accordance with Section 402.16 shall not be required to comply with the flame spread and smoke-developed indexes specified in Section 2603.3.

402.16.5.1 Density. The minimum density of foam plastics used in signs shall not be less than 20 pounds per cubic foot (pcf) (320 kg/m^3).

402.16.5.2 Thickness. The thickness of foam plastic signs shall not be greater than 1/2 inch (12.7 mm).

[F] 402.17 Fire department access to equipment. Rooms or areas containing controls for air-conditioning systems, automatic fire-extinguishing systems or other detection, suppression or control elements shall be identified for use by the fire department.

SECTION 403
HIGH-RISE BUILDINGS

403.1 Applicability. High-rise buildings shall comply with Sections 403.2 through 403.6.

Exception: The provisions of Sections 403.2 through 403.6 shall not apply to the following buildings and structures:

1. Airport traffic control towers in accordance with Section 412.3.
2. Open parking garages in accordance with Section 406.3.

3. Buildings with a Group A-5 occupancy in accordance with Section 303.1.
4. Special industrial occupancies in accordance with Section 503.1.1.
5. Buildings with a Group H-1, H-2 or H-3 occupancy in accordance with Section 415.

403.2 Construction. The construction of high-rise buildings shall comply with the provisions of Sections 403.2.1 through 403.2.4.

403.2.1 Reduction in fire-resistance rating. The *fire-resistance-rating* reductions listed in Sections 403.2.1.1 and 403.2.1.2 shall be allowed in buildings that have sprinkler control valves equipped with supervisory initiating devices and water-flow initiating devices for each floor.

403.2.1.1 Type of construction. The following reductions in the minimum *fire-resistance rating* of the building elements in Table 601 shall be permitted as follows:

1. For buildings not greater than 420 feet (128 m) in *bUilding height,* the *fire-resistance rating* of the building elements in Type IA construction shall be permitted to be reduced to the minimum *fire-resistance ratings* for the building elements in Type lB.

   Exception: The required *fire-resistance rating* of columns supporting floors shall not be permitted to be reduced.

2. In other than Group F-1, M and S-1 occupancies, the *fire-resistance rating* of the building elements in Type IB construction shall be permitted to be reduced to the *fire-resistance ratings* in Type IIA.
3. The *building height* and *building area* limitations of a building containing building elements with reduced *fire-resistance ratings* shall be permitted to be the same as the building without such reductions.

403.2.1.2 Shaft enclosures. For buildings not greater than 420 feet (128 m) in *bUilding height,* the required *fire-resistance rating* of the *fire barriers* enclosing vertical shafts, other than *exit enclosures* and elevator hoistway enclosures, is permitted to be reduced to 1 hour where automatic sprinklers are installed within the shafts at the top and at alternate floor levels.

403.2.2 Seismic considerations. For seismic considerations, see Chapter 16.

403.2.3 Structural integrity of exit enclosures and elevator hoistway enclosures. For high-rise buildings of occupancy category III or IV in accordance with Section 1604.5, and for all buildings that are more than 420 feet (128 m) in *building height, exit enclosures* and elevator hoistway enclosures shall comply with Sections 403.2.3.1 through 403.2.3.4.

403.2.3.1 Wall assembly. The wall assemblies making up the *exit enclosures* and elevator hoistway enclosures shall meet or exceed Soft Body Impact Classification Level 2 as measured by the test method described in ASTM C 1629/C 1629M.

403.2.3.2 Wall assembly materials. The face of the wall assemblies making up the *exit enclosures* and elevator hoistway enclosures that are not exposed to the interior of the *exit enclosure* or elevator hoistway enclosure shall be constructed in accordance with one of the following methods:

1. The wall assembly shall incorporate not less than two layers of impact-resistant construction board each of which meets or exceeds Hard Body Impact Classification Level 2 as measured by the test method described in ASTM C 1629/C 1629M.
2. The wall assembly shall incorporate not less than one layer of impact-resistant construction material that meets or exceeds Hard Body Impact Classification Level 3 as measured by the test method described in ASTM C 1629/C 1629M.
3. The wall assembly incorporates multiple layers of any material, tested in tandem, that meet or exceed Hard Body Impact Classification Level 3 as measured by the test method described in ASTM C 1629/C 1629M.

403.2.3.3 Concrete and masonry walls. Concrete or masonry walls shall be deemed to satisfy the requirements of Sections 403.2.3.1 and 403.2.3.2.

403.2.3.4 Other wall assemblies. Any other wall assembly that provides impact resistance equivalent to that required by Sections 403.2.3.1 and 403.2.3.2 for Hard Body Impact Classification Level 3, as measured by the test method described in ASTM C 1629/C 1629M, shall be permitted.

403.2.4 Sprayed fire-resistant materials (SFRM). The bond strength of the SFRM installed throughout the building shall be in accordance with Table 403.2.4.

TABLE 403.2.4
MINIMUM BOND STRENGTH

HEIGHT OF BUILDING[a]	SFRM MINIMUM BOND STRENGTH
Up to 420 feet	430 psf
Greater than 420 feet	1,000psf

For 51: 1 foot = 304.8 mm, 1 pound per square foot (pst) = 0.0479 kW/m²

a. Above the lowest level of fire department vehicle access.

[F] 403.3 Automatic sprinkler system. Buildings and structures shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 and a secondary water supply where required by Section 903.3.5.2.

Exception: An *automatic sprinkler system* shall not be required in spaces or areas of:

1. *Open parking garages* in accordance with Section 406.3.
2. Telecommunications equipment buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces

or areas are equipped throughout with an automatic fire detection system in accordance with Section 907.2 and are separated from the remainder of the building by not less than I-hour *fire barriers* constructed in accordance with Section 707 or not less than 2-hour *horizontal assemblies* constructed in accordance with Section 712, or both.

[F] 403.3.1 Number of sprinkler risers and system design. Each sprinkler system zone in buildings that are more than 420 feet (128 m) in *building height* shall be supplied by a minimum of two risers. Each riser shall supply sprinklers on alternate floors. If more than two risers are provided for a zone, sprinklers on adjacent floors shall not be supplied from the same riser.

[F] 403.3.1.1 Riser location. Sprinkler risers shall be placed in *exit enclosures* that are remotely located in accordance with Section 1015.2.

[F] 403.3.2 Water supply to required fire pumps. Required fire pumps shall be supplied by connections to a minimum of two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through at least one of the connections.

403.4 Emergency systems. The detection, alarm and emergency systems of high-rise buildings shall comply with Sections 403.4.1 through 403.4.8.

[F] 403.4.1 Smoke detection. Smoke detection shall be provided in accordance with Section 907.2.13.1.

[F] 403.4.2 Fire alarms systems. A fire alarm system shall be provided in accordance with Section 907.2.13.

[F] 403.4.3 Emergency voice/alarm communication system. An emergency voice/alarm communication system shall be provided in accordance with Section 907.5.2.2.

[F] 403.4.4 Emergency responder radio coverage. Emergency responder radio coverage shall be provided in accordance with Section 510 of the *International Fire Code.*

[F] 403.4.5 Fire command. A fire command center complying with Section 911 shall be provided in a location *approved* by the fire department.

403.4.6 Smoke removal. To facilitate smoke removal in post-fire salvage and overhaul operations, buildings and structures shall be equipped with natural or mechanical ventilation for removal of products of combustion in accordance with one of the following:

1. Easily identifiable, manually operable windows or panels shall be distributed around the perimeter of each floor at not more than 50-foot (15 240 mm) intervals. The area of operable windows or panels shall not be less than 40 square feet (3.7 m^2) per 50 linear feet (15 240 mm) of perimeter.

   Exceptions:

   1. In Group R-1 occupancies, each *sleeping unit* or suite having an *exterior wall* shall be permitted to be provided with 2 square feet (0.19 m^2) of venting area in lieu of the area specified in Item 1.
   2. Windows shall be permitted to be fixed provided that glazing can be cleared by fire fighters.

2. Mechanical air-handling equipment providing one exhaust air change every 15 minutes for the area involved. Return and exhaust air shall be moved directly to the outside without recirculation to other portions of the building.
3. Any other *approved* design that will produce equivalent results.

[F] 403.4.7 Standby power. A standby power system complying with Chapter 27 shall be provided for standby power loads specified in Section 403.4.7.2.

[F] 403.4.7.1 Special requirements for standby power systems. If the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with 2-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both. System supervision with manual start and transfer features shall be provided at the fire command center.

[F] 403.4.7.2 Standby power loads. The following are classified as standby power loads:

1. Power and lighting for the fire command center required by Section 403.4.5;
2. Ventilation and automatic fire detection equipment for smokeproof enclosures; and
3. Standby power shall be provided for elevators in accordance with Sections 1007.4,3003,3007 and 3008.

[F] 403.4.8 Emergency power systems. An emergency power system complying with Chapter 27 shall be provided for emergency power loads specified in Section 403.4.8.1.

[F] 403.4.8.1 Emergency power loads. The following are classified as emergency power loads:

1. Exit signs and *means of egress* illumination required by Chapter 10;
2. Elevator car lighting;
3. Emergency voice/alarm communications systems;
4. Automatic fire detection systems;
5. Fire alarm systems; and
6. Electrically powered fire pumps.

403.5 Means of egress and evacuation. The *means of egress* in high-rise buildings shall comply with Sections 403.5.1 through 403.5.6.

403.5.1 Remoteness of exit stairway enclosures. The required *exit stairway* enclosures shall be separated by a distance not less than 30 feet (9144 mm) or not less than one-fourth of the length of the maximum overall diagonal dimension of the building or area to be served, whichever is less. The distance shall be measured in a straight line between the nearest points of the *exit stairway* enclosures. In buildings with three or more *exit stairway* enclosures, at least two of the *exit stairway* enclosures shall comply with this section. Interlocking or *scissor stairs* shall be counted as one *exit stairway*.

403.5.2 Additional exit stairway. For buildings other than Group R-2 that are more than 420 feet (128 m) in *building height*, one additional *exit stairway* meeting the requirements of Sections 1009 and 1022 shall be provided in addition to the minimum number of *exits* required by Section 1021.1. The total width of any combination of remaining *exit stairways* with one *exit stairway* removed shall not be less than the total width required by Section 1005.1. *Scissor stairs* shall not be considered the additional *exit stairway* required by this section.

Exception: An additional *exit stairway* shall not be required to be installed in buildings having elevators used for occupant self-evacuation in accordance with Section 3008.

403.5.3 Stairway door operation. Stairway doors other than the *exit discharge* doors shall be permitted to be locked from the stairway side. Stairway doors that are locked from the stairway side shall be capable of being unlocked simultaneously without unlatching upon a signal from the fire command center.

403.5.3.1 Stairway communication system. A telephone or other two-way communications system connected to an *approved* constantly attended station shall be provided at not less than every fifth floor in each *stairway* where the doors to the *stairway* are locked.

403.5.4 Smokeproof exit enclosures. Every required level *exit stairway* serving floors more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access shall comply with Sections 909.20 and 1022.9.

403.5.5 Luminous egress path markings. Luminous egress path markings shall be provided in accordance with Section 1024.

403.5.6 Emergency escape and rescue. Emergency escape and rescue openings required by Section 1029 are not required.

403.6 Elevators. Elevator installation and operation in high-rise buildings shall comply with Chapter 30 and Sections 403.6.1 and 403.6.2.

403.6.1 Fire service access elevator. In buildings with an occupied floor more than 120 feet (36 576 mm) above the lowest level of fire department vehicle access, a minimum of one fire service access elevator shall be provided in accordance with Section 3007.

403.6.2 Occupant evacuation elevators. Where installed in accordance with Section 3008, passenger elevators for general public use shall be permitted to be used for occupant self-evacuation.

SECTION 404
ATRIUMS

404.1 General. In other than Group H occupancies, and where permitted by Exception 5 in Section 708.2, the provisions of this section shall apply to buildings or structures containing vertical openings defined herein as "Atriums."

404.1.1 Definition. The following word and term shall, for the purposes of this chapter and as used elsewhere in this code, have the meaning shown herein.

ATRIUM. An opening connecting two or more *stories* other than enclosed *stairways*, elevators, hoistways, escalators, plumbing, electrical, air-conditioning or other equipment, which is closed at the top and not defined as a mall. Stories, as used in this definition, do not include balconies within assembly groups or *mezzanines* that comply with Section 505.

404.2 Use. The floor of the atrium shall not be used for other than low fire hazard uses and only *approved* materials and decorations in accordance with the *International Fire Code* shall be used in the atrium space.

Exception: The atrium floor area is permitted to be used for any *approved* use where the individual space is provided with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

[F] 404.3 Automatic sprinkler protection. An *approved automatic sprinkler system* shall be installed throughout the entire building.

Exceptions:

1. That area of a building adjacent to or above the atrium need not be sprinklered provided that portion of the building is separated from the atrium portion by not less than 2-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both.
2. Where the ceiling of the atrium is more than 55 feet (16 764 mm) above the floor, sprinkler protection at the ceiling of the atrium is not required.

[F] 404.4 Fire alarm system. A fire alarm system shall be provided in accordance with Section 907.2.14.

404.5 Smoke control. A smoke control system shall be installed in accordance with Section 909.

Exception: Smoke control is not required for atriums that connect only two *stories*.

404.6 Enclosure of atriums. Atrium spaces shall be separated from adjacent spaces by a I-hour *fire barrier* constructed in accordance with Section 707 or a *horizontal assembly* constructed in accordance with Section 712, or both.

Exceptions:

1. A glass wall forming a smoke partition where automatic sprinklers are spaced 6 feet (1829 mm) or less along both sides of the separation wall, or on the room side only if there is not a walkway on the atrium side, and between 4 inches and 12 inches (102 mm and 305 mm) away from the glass and designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction. The glass shall be installed in a gasketed frame so that the framing system deflects without breaking (loading) the glass before the sprinkler system operates.
2. A glass-block wall assembly in accordance with Section 2110 and having a 3/4-hour *fire protection rating*.
3. The adjacent spaces of any three *floors* of the atrium shall not be required to be separated from the atrium where such spaces are accounted for in the design of the smoke control system.

[F] 404.7 Standby power. Equipment required to provide smoke control shall be connected to a standby power system in accordance with Section 909.11.

404.8 Interior finish. The *interior finish* of walls and ceilings of the atrium shall not be less than Class B with no reduction in class for sprinkler protection.

404.9 Travel distance. In other than the lowest level of the atrium, where the required *means of egress* is through the atrium space, the portion of *exit access* travel distance within the atrium space shall not exceed 200 feet (60 960 mm). The travel distance requirements for areas of buildings open to the atrium and where access to the *exits* is not through the atrium, shall comply with the requirements of Section 1016.

SECTION 405
UNDERGROUND BUILDINGS

405.1 General. The provisions of this section apply to building spaces having a floor level used for human occupancy more than 30 feet (9144 mm) below the finished floor of the lowest *level of exit discharge*.

Exceptions:

1. One- and two-family *dwellings*, sprinklered in accordance with Section 903.3.1.3.
2. Parking garages with automatic sprinkler systems in compliance with Section 405.3.
3. Fixed guideway transit systems.
4. Grandstands, *bleachers*, stadiums, arenas and similar facilities.
5. Where the lowest *story* is the only *story* that would qualify the building as an underground building and has an area not exceeding 1,500 square feet (139 m^2) and has an *occupant load* less than 10.
6. Pumping stations and other similar mechanical spaces intended only for limited periodic use by service or maintenance personnel.

405.2 Construction requirements. The underground portion of the building shall be of Type I construction.

[F] 405.3 Automatic sprinkler system. The highest level of *exit discharge* serving the underground portions of the building and all levels below shall be equipped with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1. Water-flow switches and control valves shall be supervised in accordance with Section 903.4.

405.4 Compartmentation. Compartmentation shall be in accordance with Sections 405.4.1 through 405.4.3.

405.4.1 Number of compartments. A building having a floor level more than 60 feet (18 288 mm) below the finished floor of the lowest *level of exit discharge* shall be divided into a minimum of two compartments of approximately equal size. Such compartmentation shall extend through the highest *level of exit discharge* serving the underground portions of the building and all levels below.

Exception: The lowest *story need* not be compartmented where the area does not exceed 1,500 square feet (139 m^2) and has an *occupant load* of less than 10.

405.4.2 Smoke barrier penetration. The compartments shall be separated from each other by a *smoke barrier* in accordance with Section 710. Penetrations between the two compartments shall be limited to plumbing and electrical piping and conduit that are firestopped in accordance with Section 713. Doorways shall be protected by *fire door assemblies* that are automatic-closing by smoke detection in accordance with Section 715.4.8.3 and are installed in accordance with NFPA 105 and Section 715.4.3. Where provided, each compartment shall have an air supply and an exhaust system independent of the other compartments.

405.4.3 Elevators. Where elevators are provided, each compartment shall have direct access to an elevator. Where an elevator serves more than one compartment, an elevator lobby shall be provided and shall be separated from each compartment by a *smoke barrier* in accordance with Section 710. Doors shall be gasketed, have a drop sill and be automatic-closing by smoke detection in accordance with Section 715.4.8.3.

[F] 405.5 Smoke control system. A smoke control system shall be provided in accordance with Sections 405.5.1 and 405.5.2.

[F] 405.5.1 Control system. A smoke control system is required to control the migration of products of combustion in accordance with Section 909 and the provisions of this section. Smoke control shall restrict movement of smoke to the general area of fire origin and maintain *means of egress* in a usable condition.

[F] 405.5.2 Compartment smoke control system. Where compartmentation is required, each compartment shall have an independent smoke control system. The system shall be automatically activated and capable of manual operation in accordance with Sections 907.2.18 and 907.2.19.

[F] 405.6 Fire alarm systems. A fire alarm system shall be provided where required by Sections 907.2.18 and 907.2.19.

405.7 Means of egress. *Means of egress* shall be in accordance with Sections 405.7.1 and 405.7.2.

405.7.1 Number of exits. Each floor level shall be provided with a minimum of two *exits*. Where compartmentation is required by Section 405.4, each compartment shall have a

minimum of one *exit* and shall also have an *exit access* doorway into the adjoining compartment.

405.7.2 Smokeproof enclosure. Every required *stairway* serving floor levels more than 30 feet (9144 mm) below the finished floor of its *level of exit discharge* shall comply with the requirements for a smokeproof enclosure as provided in Section 1022.9.

[F] 405.8 Standby power. A standby power system complying with Chapter 27 shall be provided standby power loads specified in Section 405.8.1.

[F] 405.8.1 Standby power loads. The following loads are classified as standby power loads:

1. Smoke control system.
2. Ventilation and automatic fire detection equipment for smokeproof enclosures.
3. Fire pumps.

Standby power shall be provided for elevators in accordance with Section 3003.

[F] 405.8.2 Pick-up time. The standby power system shall pick up its connected loads within 60 seconds of failure of the normal power supply.

[F] 405.9 Emergency power. An emergency power system complying with Chapter 27 shall be provided for emergency power loads specified in Section 405.9.1.

[F] 405.9.1 Emergency power loads. The following loads are classified as emergency power loads:

1. Emergency voicelalarm communications systems.
2. Fire alarm systems.
3. Automatic fire detection systems.
4. Elevator car lighting.
5. *Means of egress* and exit sign illumination as required by Chapter 10.

[F] 405.10 Standpipe system. The underground building shall be equipped throughout with a standpipe system in accordance with Section 905.

SECTION 406
MOTOR-VEHICLE-RELATED OCCUPANCIES

406.1 Private garages and carports.

406.1.1 Classification. Buildings or parts of buildings classified as Group U occupancies because of the use or character of the occupancy shall not exceed 1,000 square feet (93 m^2) in area or one *story* in height except as provided in Section 406.1.2. Any building or portion thereof that exceeds the limitations specified in this section shall be classified in the occupancy group other than Group U that it most nearly resembles.

406.1.2 Area increase. Group U occupancies used for the storage of private or pleasure-type motor vehicles where no repair work is completed or fuel is dispensed are permitted to be 3,000 square feet (279 m^2) when the following provisions are met:

1. For a mixed occupancy building, the *exterior wall* and opening protection for the Group U portion of the building shall be as required for the major occupancy of the building. For such a mixed occupancy building, the allowable floor area of the building shall be as permitted for the major occupancy contained therein.
2. For a building containing only a Group U occupancy, the *exterior wall* shall not be required to have a *fire-resistance rating* and the area of openings shall not be limited when the *fire separation distance* is 5 feet (1524 mm) or more.

More than one 3,000-square-foot (279 m^2) Group U occupancy shall be permitted to be in the same building, provided each 3,000-square-foot (279 m^2) area is separated by *fire walls* complying with Section 706.

406.1.3 Garages and carports. Carports shall be open on at least two sides. Carport floor surfaces shall be of *approved* noncombustible material. Carports not open on at least two sides shall be considered a garage and shall comply with the provisions of this section for garages.

Exception: Asphalt surfaces shall be permitted at ground level in carports.

The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

406.1.4 Separation. Separations shall comply with the following:

1. The private garage shall be separated from the *dwelling unit* and its *attic* area by means of a minimum liz-inch (12.7 mm) gypsum board applied to the garage side. Garages beneath habitable rooms shall be separated from all habitable rooms above by not less than a sis-inch (15.9 mm) Type X gypsum board or equivalent. Door openings between a private garage and the *dwelling unit* shall be equipped with either solid wood doors or solid or honeycomb core steel doors not less than $1\frac{3}{8}$ inches (34.9 mm) thick, or doors in compliance with Section 715.4.3. Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Doors shall be self-closing and self-latching.
2. Ducts in a private garage and ducts penetrating the walls or ceilings separating the *dwelling unit* from the garage shall be constructed of a minimum 0.019-inch (0.48 mm) sheet steel and shall have no openings into the garage.
3. A separation is not required between a Group R-3 and U carport, provided the carport is entirely open on two or more sides and there are not enclosed areas above.

406.1.5 Automatic garage door openers. Automatic garage door openers, if provided, shall be *listed* in accordance with UL 325.

406.2 Parking garages.

406.2.1 Classification. Parking garages shall be classified as either open, as defined in Section 406.3, or enclosed and shall meet the appropriate criteria in Section 406.4. Also see Section 509 for special provisions for parking garages.

406.2.2 Clear height. The clear height of each floor level in vehicle and pedestrian traffic areas shall not be less than 7 feet (2134 mm). Vehicle and pedestrian areas accommodating van-accessible parking required by Section 1106.5 shall conform to ICC A117.1.

406.2.3 Guards. *Guards* shall be provided in accordance with Section 1013. *Guards* serving as vehicle barrier systems shall comply with Sections 406.2.4 and 1013.

406.2.4 Vehicle barrier systems. Vehicle barrier systems not less than 2 feet 9 inches (835 mm) high shall be placed at the end of drive lanes, and at the end of parking spaces where the vertical distance to the ground or surface directly below is greater than 1 foot (305 mm). Vehicle barrier systems shall comply with the loading requirements of Section 1607.7.3.

Exception: Vehicle storage compartments in a mechanical access parking garage.

406.2.5 Ramps. Vehicle ramps shall not be considered as required *exits* unless pedestrian facilities are provided. Vehicle ramps that are utilized for vertical circulation as well as for parking shall not exceed a slope of 1:15 (6.67 percent).

406.2.6 Floor surface. Parking surfaces shall be of concrete or similar noncombustible and nonabsorbent materials.

The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

Exceptions:

1. Asphalt parking surfaces shall be permitted at ground level.
2. Floors of Group S-2 parking garages shall not be required to have a sloped surface.

406.2.7 Mixed occupancy separation. Parking garages shall be separated from other occupancies in accordance with Section 508.1.

406.2.8 Special hazards. Connection of a parking garage with any room in which there is a fuel-fired appliance shall be by means of a vestibule providing a two-doorway separation.

Exception: A single door shall be allowed provided the sources of ignition in the appliance are at least 18 inches (457 mm) above the floor.

406.2.9 Attached to rooms. Openings from a parking garage directly into a room used for sleeping purposes shall not be permitted.

406.3 Open parking garages.

406.3.1 Scope. Except where specific provisions are made in Sections 406.3.2 through 406.3.13, other requirements of this code shall apply.

406.3.2 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

MECHANICAL-ACCESS OPEN PARKING GARAGES. *Open parking garages* employing parking machines, lifts, elevators or other mechanical devices for vehicles moving from and to street level and in which public occupancy is prohibited above the street level.

OPEN PARKING GARAGE. A structure or portion of a structure with the openings as described in Section 406.3.3.1 on two or more sides that is used for the parking or storage of private motor vehicles as described in Section 406.3.4.

RAMP-ACCESS OPEN PARKING GARAGES. *Open parking garages* employing a series of continuously rising floors or a series of interconnecting ramps between floors permitting the movement of vehicles under their own power from and to the street level.

406.3.3 Construction. *Open parking garages* shall be of Type I, II or IV construction. *Open parking garages* shall meet the design requirements of Chapter 16. For vehicle barrier systems, see Section 406.2.4.

406.3.3.1 Openings. For natural ventilation purposes, the exterior side of the structure shall have uniformly distributed openings on two or more sides. The area of such openings in *exterior walls* on a tier must be at least 20 percent of the total perimeter wall area of each tier. The aggregate length of the openings considered to be providing natural ventilation shall constitute a minimum of 40 percent of the perimeter of the tier. Interior walls shall be at least 20 percent open with uniformly distributed openings.

Exception: Openings are not required to be distributed over 40 percent of the building perimeter where the required openings are uniformly distributed over two opposing sides of the building.

406.3.4 Uses. Mixed uses shall be allowed in the same building as an *open parking garage* subject to the provisions of Sections 402.7.1, 406.3.13, 508.1, 509.3, 509.4 and 509.7.

406.3.5 Area and height. Area and height of *open parking garages* shall be limited as set forth in Chapter 5 for Group S-2 occupancies and as further provided for in Section 508.1.

406.3.5.1 Single use. When the *open parking garage* is used exclusively for the parking or storage of private motor vehicles, with no other uses in the building, the area and height shall be permitted to comply with Table

406.3.5, along with increases allowed by Section 406.3.6.

Exception: The grade-level tier is permitted to contain an office, waiting and toilet rooms having a total combined area of not more than 1,000 square feet (93 m^2). Such area need not be separated from the *open parking garage.*

In *open parking garages* having a spiral or sloping floor, the horizontal projection of the structure at any cross section shall not exceed the allowable area per parking tier. In the case of an *open parking garage* having a continuous spiral floor, each 9 feet 6 inches (2896 mm) of height, or portion thereof, shall be considered a tier.

The clear height of a parking tier shall not be less than 7 feet (2134 mm), except that a lower clear height is permitted in mechanical-access *open parking garages* where *approved* by the *building official.*

406.3.6 Area and height increases. The allowable area and height of *open parking garages* shall be increased in accordance with the provisions of this section. Garages with sides open on three-fourths of the building's perimeter are permitted to be increased by 25 percent in area and one tier in height. Garages with sides open around the entire building's perimeter are permitted to be increased by 50 percent in area and one tier in height. For a side to be considered open under the above provisions, the total area of openings along the side shall not be less than 50 percent of the interior area of the side at each tier and such openings shall be equally distributed along the length of the tier.

Allowable tier areas in Table 406.3.5 shall be increased for *open parking garages* constructed to heights less than the table maximum. The gross tier area of the garage shall not exceed that permitted for the higher structure. At least three sides of each such larger tier shall have continuous horizontal openings not less than 30 inches (762 mm) in clear height extending for at least 80 percent of the length of the sides and no part of such larger tier shall be more than 200 feet (60 960 mm) horizontally from such an opening. In addition, each such opening shall face a street or *yard* accessible to a street with a width of at least 30 feet (9144 mm) for the full length of the opening, and standpipes shall be provided in each such tier.

Open parking garages of Type II construction, with all sides open, shall be unlimited in allowable area where the *bUilding height* does not exceed 75 feet (22 860 mm). For a side to be considered open, the total area of openings along the side shall not be less than 50 percent of the interior area of the side at each tier and such openings shall be equally distributed along the length of the tier. All portions of tiers shall be within 200 feet (60 960 mm) horizontally from such openings or other natural ventilation openings as defined in Section 406.3.3.1. These openings shall be permitted to be provided in *courts* with a minimum dimension of 20 feet (6096 mm) for the full width of the openings.

406.3.7 Fire separation distance. *Exterior walls* and openings in *exterior walls* shall comply with Tables 601 and 602. The distance to an adjacent *lot line* shall be determined in accordance with Table 602 and Section 705.

406.3.8 Means of egress. Where persons other than parking attendants are permitted, *open parking garages* shall meet the *means of egress* requirements of Chapter 10. Where no persons other than parking attendants are permitted, there shall not be less than two 36-inch-wide (914 mm) *exit stairways.* Lifts shall be permitted to be installed for use of employees only, provided they are completely enclosed by noncombustible materials.

406.3.9 Standpipes. Standpipes shall be installed where required by the provisions of Chapter 9.

406.3.10 Sprinkler systems. Where required by other provisions of this code, *automatic sprinkler systems* and standpipes shall be installed in accordance with the provisions of Chapter 9.

406.3.11 Enclosure of vertical openings. Enclosure shall not be required for vertical openings except as specified in Section 406.3.8.

406.3.12 Ventilation. Ventilation, other than the percentage of openings specified in Section 406.3.3.1, shall not be required.

406.3.13 Prohibitions. The following uses and alterations are not permitted:

1. Vehicle repair work.
2. Parking of buses, trucks and similar vehicles.

TABLE 406.3.5
OPEN PARKING GARAGES AREA AND HEIGHT

TYPE OF CONSTRUCTION	AREA PER TIER (square feet)	HEIGHT (in tiers)		
			Mechanical access	
			Automatic sprinkler system	
		Ramp access	No	Yes
IA	Unlimited	Unlimited	Unlimited	Unlimited
IB	Unlimited	12 tiers	12 tiers	18 tiers
IIA	50,000	10 tiers	10 tiers	15 tiers
lIB	50,000	8 tiers	8 tiers	12 tiers
IV	50,000	4 tiers	4 tiers	4 tiers

For 51: 1 square foot = 0.0929 m^2.

tion 909 or natural ventilation designed to maintain the smoke level at least 6 feet (1829 mm) above the floor of the *means of egress.*

410.3.6 Scenery. Combustible materials used in sets and scenery shall meet the fire propagation performance criteria of NFPA 701, in accordance with Section 806 and the *International Fire Code.* Foam plastics and materials containing foam plastics shall comply with Section 2603 and the *International Fire Code.*

410.3.7 Stage ventilation. Emergency ventilation shall be provided for stages larger than 1,000 square feet (93 m^2) in floor area, or with a stage height greater than 50 feet (15 240 mm). Such ventilation shall comply with Section 410.3.7.1 or 410.3.7.2.

410.3.7.1 Roof vents. Two or more vents constructed to open automatically by *approved* heat-activated devices and with an aggregate clear opening area of not less than 5 percent of the area of the stage shall be located near the center and above the highest part of the stage area. Supplemental means shall be provided for manual operation of the ventilator. Curbs shall be provided as required for skylights in Section 2610.2. Vents shall be labeled.

[F] 410.3.7.2 Smoke control. Smoke control in accordance with Section 909 shall be provided to maintain the smoke layer interface not less than 6 feet (1829 mm) above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is provided in compliance with Section 410.3.4.

410.4 Platform construction. Permanent platforms shall be constructed of materials as required for the type of construction of the building in which the permanent platform is located. Permanent platforms are permitted to be constructed of *fire-retardant-treated wood for* Types I, II and IV construction where the platforms are not more than 30 inches (762 mm) above the main floor, and not more than one-third of the room floor area and not more than 3,000 square feet (279 m^2) in area. Where the space beneath the permanent platform is used for storage or any purpose other than equipment, wiring or plumbing, the floor assembly shall not be less than I-hour fire-resistance-rated construction. Where the space beneath the permanent platform is used only for equipment, wiring or plumbing, the underside of the permanent platform need not be protected.

410.4.1 Temporary platforms. Platforms installed for a period of not more than 30 days are permitted to be constructed of any materials permitted by the code. The space between the floor and the platform above shall only be used for plumbing and electrical wiring to platform equipment.

410.5 Dressing and appurtenant rooms. Dressing and appurtenant rooms shall comply with Sections 410.5.1 through 410.5.3.

410.5.1 Separation from stage. The stage shall be separated from dressing rooms, scene docks, property rooms, workshops, storerooms and compartments appurtenant to the stage and other parts of the building by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both. The minimum *fire-resistance rating* shall be 2 hours for stage heights greater than 50 feet (15 240 mm) and 1 hour for stage heights of 50 feet (15 240 mm) or less.

410.5.2 Separation from each other. Dressing rooms, scene docks, property rooms, workshops, storerooms and compartments appurtenant to the stage shall be separated from each other by not less than I-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both.

410.5.3 Stage exits. At least one *approved means of egress* shall be provided from each side of the stage and from each side of the space under the stage. At least one means of escape shall be provided from each fly gallery and from the gridiron. A steel ladder, *alternating tread device* or *spiral stairway* is permitted to be provided from the gridiron to a scuttle in the stage roof.

[F] 410.6 Automatic sprinkler system. Stages shall be equipped with an automatic fire-extinguishing system in accordance with Chapter 9. Sprinklers shall be installed under the roof and gridiron and under all catwalks and galleries over the stage. Sprinklers shall be installed in dressing rooms, performer lounges, shops and storerooms accessory to such stages.

Exceptions:

1. Sprinklers are not required under stage areas less than 4 feet (1219 mm) in clear height that are utilized exclusively for storage of tables and chairs, provided the concealed space is separated from the adjacent spaces by not less than $5/_8$-inch (15.9 mm) Type X gypsum board.
2. Sprinklers are not required for stages 1,000 square feet (93 m^2) or less in area and 50 feet (15 240 mm) or less in height where curtains, scenery or other combustible hangings are not retractable vertically. Combustible hangings shall be limited to a single main curtain, borders, legs and a single backdrop.
3. Sprinklers are not required within portable orchestra enclosures on stages.

[F] 410.7 Standpipes. Standpipe systems shall be provided in accordance with Section 905.

SECTION 411
SPECIAL AMUSEMENT BUILDINGS

411.1 General. Special *amusement bUildings* having an *occupant load* of 50 or more shall comply with the requirements for the appropriate Group A occupancy and Sections 411.1 through 411.8. Amusement buildings having an *occupant load* of less than 50 shall comply with the requirements for a Group B occupancy and Sections 411.1 through 411.8.

Exception: Amusement buildings or portions thereof that are without walls or a roof and constructed to prevent the accumulation of smoke.

For flammable *decorative materials,* see the *International Fire Code.*

411.2 Definition. The following word and term shall, for the purpose of this section and as used elsewhere in this code, have the meaning shown herein.

SPECIAL AMUSEMENT BUILDING. A *special amusement bUilding* is any temporary or permanent building or portion thereof that is occupied for amusement, entertainment or educational purposes and that contains a device or system that conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the *means of egress* path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available because of the nature of the attraction or mode of conveyance through the building or structure.

[F] 411.3 Automatic fire detection. *Special amusement buildings* shall be equipped with an automatic fire detection system in accordance with Section 907.

[F] 411.4 Automatic sprinkler system. *Special amusement buildings* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1. Where the *special amusement bUilding* is temporary, the sprinkler water supply shall be of an *approved* temporary means.

Exception: Automatic sprinklers are not required where the total floor area of a temporary *special amusement building* is less than 1,000 square feet (93 m^2) and the travel distance from any point to an *exit* is less than 50 feet (15 240 mm).

[F] 411.5 Alarm. Actuation of a single smoke detector, the *automatic sprinkler system* or other automatic fire detection device shall immediately sound an alarm at the building at a *constantly attended location* from which emergency action can be initiated including the capability of manual initiation of requirements in Section 907.2.12.2.

[F] 411.6 Emergency voice/alarm communications system. An emergency voice/alarm communications system shall be provided in accordance with Sections 907.2.12 and 907.5.2.2, which is also permitted to serve as a public address system and shall be audible throughout the entire *special amusement bUilding.*

411.7 Exit marking. Exit signs shall be installed at the required *exit* or *exit access* doorways of amusement buildings in accordance with this section and Section 1011. *Approved* directional exit markings shall also be provided. Where mirrors, mazes or other designs are utilized that disguise the path of egress travel such that they are not apparent, *approved* and *listedlow-Ievel* exit signs that comply with Section 1011.4, and directional path markings *listed* in accordance with UL 1994, shall be provided and located not more than 8 inches (203 mm) above the walking surface and on or near the path of egress travel. Such markings shall become visible in an emergency. The directional exit marking shall be activated by the automatic fire detection system and the *automatic sprinkler system* in accordance with Section 907.2.12.2.

411.7.1 Photo luminescent exit signs. Where photo luminescent *exit* signs are installed, activating light source and viewing distance shall be in accordance with the listing and markings of the signs.

411.8 Interior finish. The *interior finish* shall be Class A in accordance with Section 803.1.

SECTION 412
AIRCRAFT-RELATED OCCUPANCIES

412.1 General. Aircraft-related occupancies shall comply with Sections 412.1 through 412.7 and the *International Fire Code.*

412.2 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

FIXED BASE OPERATOR (FBO). A commercial business granted the right by the airport sponsor to operate on an airport and provide aeronautical services, such as fueling, hangaring, tie-down and parking, aircraft rental, aircraft maintenance and flight instruction.

HELIPORT. An area of land or water or a structural surface that is used, or intended for the use, for the landing and taking off of helicopters, and any appurtenant areas that are used, or intended for use, for heliport buildings or other heliport facilities.

HELISTOP. The same as "heliport," except that no fueling, defueling, maintenance, repairs or storage of helicopters is permitted.

RESIDENTIAL AIRCRAFT HANGAR. An accessory building less than 2,000 square feet (186 m^2) and 20 feet (6096 mm) in *building height* constructed on a one- or two-family property where aircraft are stored. Such use will be considered as a residential accessory use incidental to the *dwelling.*

TRANSIENT AIRCRAFT. Aircraft based at another location and at the transient location for not more than 90 days.

412.3 Airport traffic control towers.

412.3.1 General. The provisions of Sections 412.3.1 through 412.3.6 shall apply to airport traffic control towers not exceeding 1,500 square feet (140 m^2) per floor occupied only for the following uses:

1. Airport traffic control cab.
2. Electrical and mechanical equipment rooms.
3. Airport terminal radar and electronics rooms.
4. Office spaces incidental to the tower operation.
5. Lounges for employees, including sanitary facilities.

412.3.2 Type of construction. Airport traffic control towers shall be constructed to comply with the height and area limitations of Table 412.3.2.

TABLE 412.3.2
HEIGHT AND AREA LIMITATIONS FOR AIRPORT TRAFFIC CONTROL TOWERS

TYPE OF CONSTRUCTION	HEIGHT[a] (feet)	MAXIMUM AREA (square feet)
IA	Unlimited	1,500
IB	240	1,500
IIA	100	1,500
IIB	85	1,500
IIIA	65	1,500

For 51: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2.
a. Height to be measured from grade plane to cab floor.

2. The building shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
3. The building shall be surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.

507.7 Group A-3 buildings of Types III and IV construction. The area of a Group A-3 building no more than one *story above grade plane,* used as a *place ofreligious worship,* community hall, dance hall, exhibition hall, gymnasium, lecture hall, indoor swimming pool or tennis court of Type III or IV construction, shall not be limited when all of the following criteria are met:

1. The building shall not have a stage other than a platform.
2. The building shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
3. The assembly floor shall be located at or within 21 inches (533 mm) of street or grade level and all *exits* are provided with ramps complying with Section 1010.1 to the street or grade level.
4. The building shall be surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18288 mm) in width.

507.8 Group H occupancies. Group H-2, H-3 and H-4 occupancies shall be permitted in unlimited area buildings containing Group F and S occupancies, in accordance with Sections 507.3 and 507.4 and the limitations of this section. The aggregate floor area of the Group H occupancies located at the perimeter of the unlimited area building shall not exceed 10 percent of the area of the building nor the area limitations for the Group H occupancies as specified in Table 503 as modified by Section 506.2, based upon the percentage of the perimeter of each Group H floor area that fronts on a street or other unoccupied space. The aggregate floor area of Group H occupancies not located at the perimeter of the building shall not exceed 25 percent of the area limitations for the Group H occupancies as specified in Table 503. Group H occupancies shall be separated from the rest of the unlimited area building and from each other in accordance with Table 508.4. For two-story unlimited area buildings, the Group H occupancies shall not be located more than one *story above grade plane* unless permitted by the allowable height in stories and feet as set forth in Table 503 based on the type of construction of the unlimited area building.

507.9 Aircraft paint hangar. The area of a Group H-2 aircraft paint hangar no more than one *story above grade plane* shall not be limited where such aircraft paint hangar complies with the provisions of Section 412.6 and is surrounded and adjoined by *public ways* or *yards* not less in width than one and one-half times the *building height.*

507.10 Group E buildings. The area of a Group E building no more than one *story above grade plane,* of Type II, IlIA or IV construction, shall not be limited when all of the following criteria are met:

1. Each classroom shall have not less than two *means of egress,* with one of the *means ofegress* being a direct *exit* to the outside of the building complying with Section 1020.
2. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
3. The building is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.

507.11 Motion picture theaters. In buildings of Type II construction, the area of a motion picture theater located on the first *story above grade plane* shall not be limited when the building is provided with an *automatic sprinkler system* throughout in accordance with Section 903.3.1.1 and is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.

507.12 Covered mall buildings and anchor stores. The area of *covered mall buildings* and *anchor stores* not exceeding three *stories* in height that comply with Section 402.6 shall not be limited.

SECTION 508
MIXED USE AND OCCUPANCY

508.1 General. Each portion of a building shall be individually classified in accordance with Section 302.1. Where a building contains more than one occupancy group, the building or portion thereof shall comply with the applicable provisions of Section 508.2,508.3 or 508.4, or a combination of these sections.

Exceptions:

1. Occupancies separated in accordance with Section 509.
2. Where required by Table 415.3.2, areas of Group H-1, H-2 and H-3 occupancies shall be located in a separate and detached building or structure.
3. Uses within live/work units, complying with Section 419, are not considered separate occupancies.

508.2 Accessory occupancies. Accessory occupancies are those occupancies that are ancillary to the main occupancy of the building or portion thereof. Accessory occupancies shall comply with the provisions of Sections 508.2.1 through 508.2.5.3.

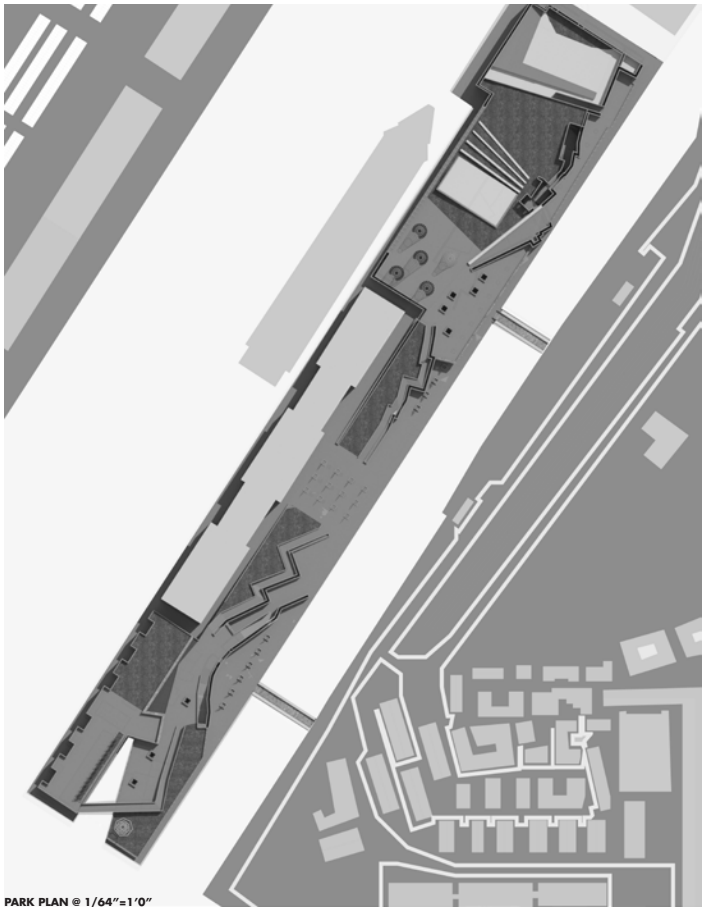
508.2.1 Area limitations. Aggregate accessory occupancies shall not occupy more than 10 percent of the *building area* of the *story* in which they are located and shall not exceed the tabular values in Table 503, without *building area* increases in accordance with Section 506 for such accessory occupancies.

508.2.2 Occupancy classification. Accessory occupancies shall be individually classified in accordance with Section 302.1. The requirements of this code shall apply to each portion of the building based on the occupancy classification of that space.

508.2.3 Allowable building area and height. The allowable *building area and height* of the building shall be based on the allowable *bUilding area andheight* for the main occupancy in accordance with Section 503.1. The height of each accessory occupancy shall not exceed the tabular values in

7.

APPENDIX



PARK PLAN @ 1/64"=1'0"

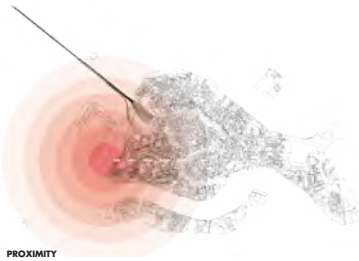
CLEAN VENICE

INFRASTRUCTURE DESIGN AND PLACE MAKING IN VENICE, ITALY.

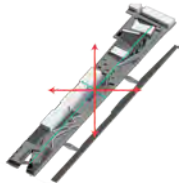
PLAZA AT GROUND LEVEL

GREENSPACE

WASTE COLLECTION: VENICE



PROXIMITY



AXIS

TRANSPORTATION

VENICE CALLOUT

STRUCTURAL GRID

ADDITION

BRIDGING

WIND ROSE

WATER

FOLLY LOCATION

GREENSCAPE

HARDSCAPE

LIGHTWELLS

EXISTING

PLANTING

PUBLIC VS. PRIVATE

RAMPS

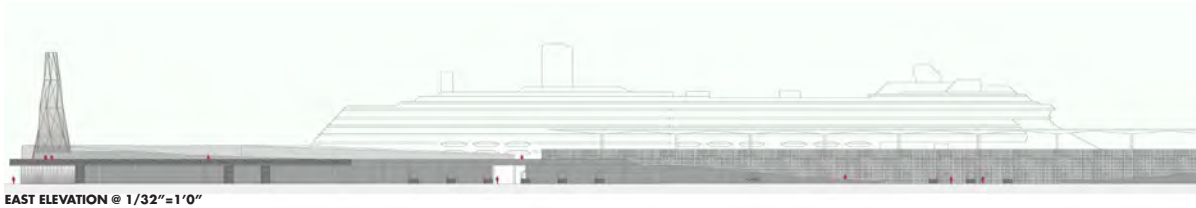
RECREATION

REMOVED

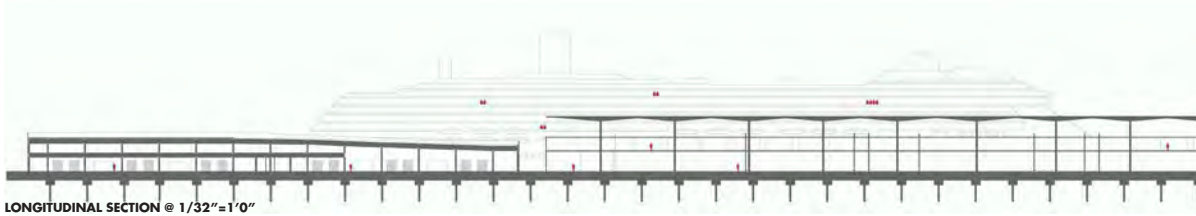
GROUND PLAN @ 1/64″=1′0″

SOUTH INTERIOR GARDEN

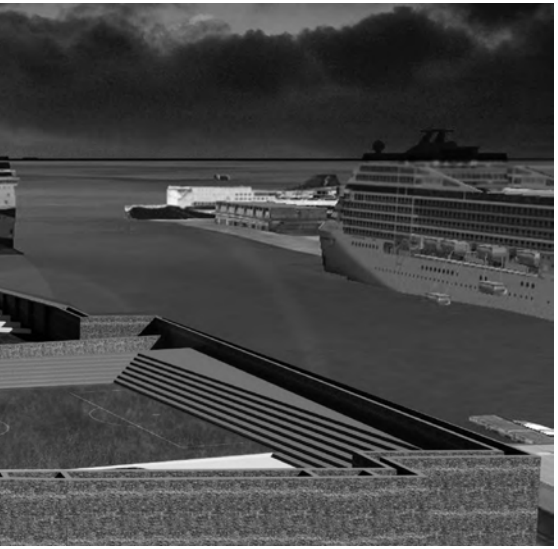
PARKSCAPE FROM NORTH PLAYING FIELDS



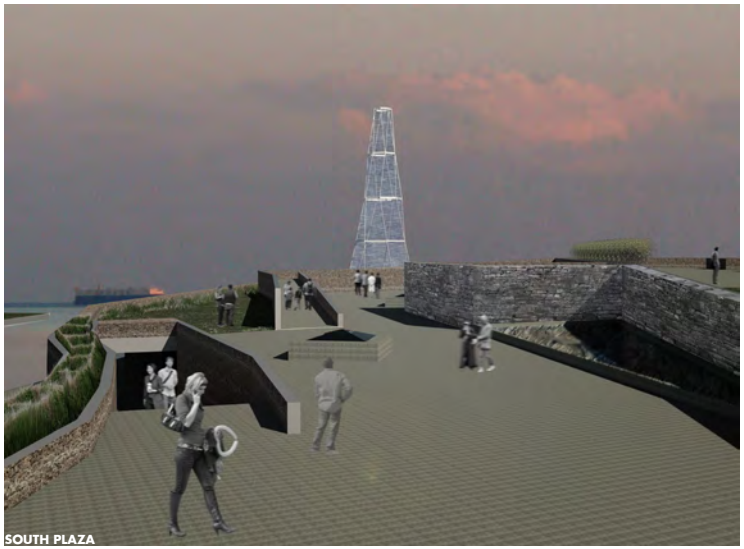
EAST ELEVATION @ 1/32″=1′0″



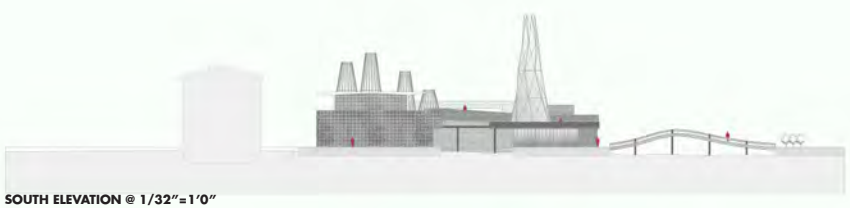
LONGITUDINAL SECTION @ 1/32″=1′0″



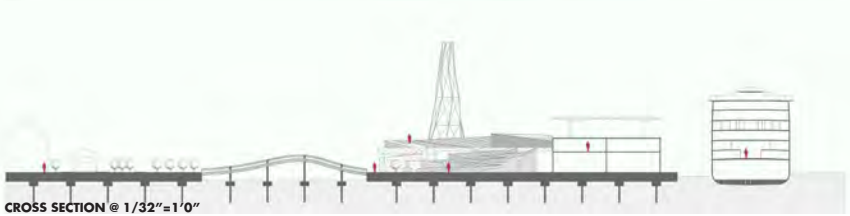
PARK ENTRANCE FROM RETAIL



SOUTH PLAZA



SOUTH ELEVATION @ 1/32"=1'0"



CROSS SECTION @ 1/32"=1'0"

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- http://www.archidose.org/Apr01/040901a.html
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- **Tschumi, Bernard, and Rem Koolhaas. "2 Architects 10 Questions on Program." PRAXIS 8 (2006): 6-15. Print.**

ALL IMAGES GATHERED FROM FLICKR + GOOGLE EARTH

1. SMAQ IS AN OPERATING STUDIO FOR ARCHITECTURE, URBANISM, AND RESEARCH. BATH IS A PROJECT WHICH CAN INSPIRE THE FOLLIES FOR WHICH I AM PROPOSING IN VENICE.
2. BRIEF OVERVIEW OF TOYO ITO'S TOWER OF WINDS
3. TOYO ITO AND ASSOCIATES, ARCHITECT'S WEBSITE
4. IN DEPTH ANALYSIS OF WIND TURBINES, AND APPROXIMATE AMOUNT OF OUTPUT POWER THAT TURBINES PRODUCE
5. INTERVIEW WITH FRANK GEHRY ABOUT HIS TAKE ON LEED BUILDINGS
6. SOLAR PAYOFF PERIOD
7. ENVIRONMENTAL TECTONICS AND CLIMATE CHANGE
8. REM KOOLHAUS' TAKE ON URBANISM, DENSITY AND CONTEXT
9. A REVIEW OF THE KUROKAWA'S METABILIST PHILOSOPHY
10. PROJECTS EXPLORING MORPHOLOGY, INSTALLMENTS THAT CHANGE WITH CLIMATE
11. EXTENSIVE PROJECT INFORMATION ON BERNARD TSCHUMI'S PARC DE LA VILLETE
12. WEBSITE EXPLAINING POLLUTION PROBLEMS IN VENICE, AND HOW THEY PLAN ON SOLVING THEM
13. DESCRIPTION OF GRAND CANAL, IN VENICE, ITALY
14. CULTURAL HISTORY AND URBAN PLANNING IN VENICE, ITALY
15. SEWAGE DISPOSAL: STRUCTURAL RISKS AND HEALTH RISKS IN VENICE, ITALY
16. CLIMATE INFORMATION IN VENICE, ITALY: WINDS
17. CLIMATE INFORMATION IN VENICE, ITALY: TEMPERATURE AND PRECIPITATION
18. INFORMATION ON BIG'S WASTE MANAGEMENT PLANT
19. BJARKI INGELS GROUP, ARCHITECT'S WEBSITE
20. PROJECT PAGE FOR WASTE TREATMENT FACILITY OF VALLES OCCIDENTAL AREA
21. BRIEF INFORMATION FOR WASTE TREATMENT FACILITY BY BATTLEIROIG ARCHITECTS
22. CLIMATE CHANGE (2007) IMPACTS, ADAPTATION AND VULNERABILITY
23. HOW DO CRUISE SHIPS IMPACT THE ENVIRONMENT
24. KENNEDY + VIOLICH ARCHITECTURE, PROJECT PAGE FOR WATER PURIFICATION BUILDING
25. MAIGRET ARQUERO DESIGN STUDIO (MADE) ENVIRONMENTALLY AND CULTURALLY SOUND PROJECTS
26. SEWAGE AND GREYWATER RECYCLING ON CRUISE SHIPS
27. DEFINITION OF GREYWATER RECYLING
28. VENICE' STAND TO BAN GIANT CRUISE SHIPS IN FRONT OF ST' MARKS SQUARE
29. URBAN DESIGN THROUGH HISTORICAL DEVELOPMENT
30. HOW DESIGN IS APPROACHED FROM 8 CONTEMPORARY ARCHITECTS
31. UNDERSTANDING PROGRAM THROUGH CONVERSATION WITH KOOLHAAS AND TSCHUMI

BIGNESS
KUROKAWA

ASSIGNMENT 1_SEPTEMBER 10_THESIS PREP_PROFESSOR HASAN KHAN_SAAHP_NICHOLAS MUSILLI

"IN BIGNESS, THE DISTANCE BETWEEN CORE AND ENVELOPE INCREASES TO THE POINT WHERE THE FACADE CAN NO LONGER REVEAL WHAT HAPPENS INSIDE. THE HUMANIST EXPECTATION OF **HONESTY** IS DOOMED: INTERIOR AND EXTERIOR ARCHITECTURES BECOME SEPARATE PROJECTS, ONE DEALING WITH THE INSTABILITY OF PROGRAMMATIC AND INCONOGRAPHIC NEEDS, THE OTHER AGENT OF DISINFORMATION--OFFERING THE CITY THE APPARANT STABILITY OF AN OBJECT." [500-501]

F#&K CONTEXT

"TOGETHER, ALL THESE BREAKS WITH SCALE, WITH ARCHITECTURAL COMPOSITION, WITH TRADITION, WITH TRANSPARANCY, WITH ETHICS-IMPLY THE FINAL, MOST RADICAL BREAK: BIGNESS IS NO LONGER PART OF ANY URBAN TISSUE.

IT EXISTS; AT MOST IT COEXISTS. ITS SUBTEXT IS FUCK CONTEXT." [502]

"TURNING TORSO", MALMO, SWEDEN 2005, SANTIAGO CALATRAVA

"BIGNESS IS **IMPERSONAL**: THE ARCHITECT IS NO LONGER CONDEMNED TO STARDOM." [513]

WEISSENHOF ESTATE
STUTTGART, GERMANY 1927
MIES
CORB
TAUT
GROPIUS
BEHRENS
SCHAROUN

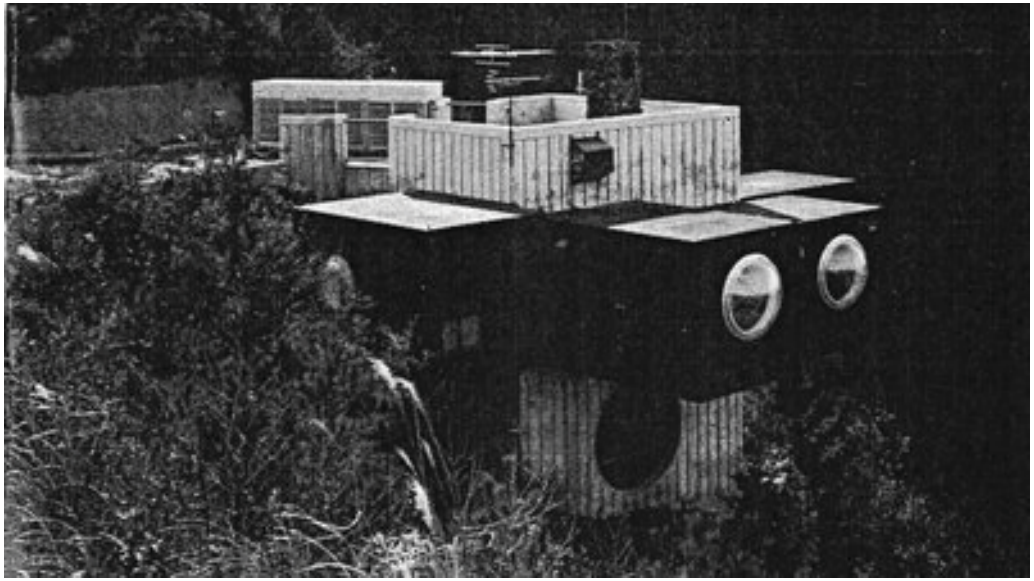
TO NAME A FEW....

TRUMP WORLD TOWER
NEW YORK, NEW YORK 2001
RUDZKA

"BEYOND SIGNATURE, **BIGNESS MEANS SURRENDER** TO TECHNOLOGIES; TO ENGINEERS, CONTRACTORS, MANUFACTURERS; TO POLITICS; TO OTHERS. IT PROMISES ARCHITECTURE A KIND OF POST-HEROIC STATUS-A REALIGNMENT WITH NEUTRALITY." [514]

GETTY CENTER, LOS ANGELES, CALIFORNIA 1997, RICHARD MEIER

CAPSULED VILLA, JAPAN 1972, KUROKAWA

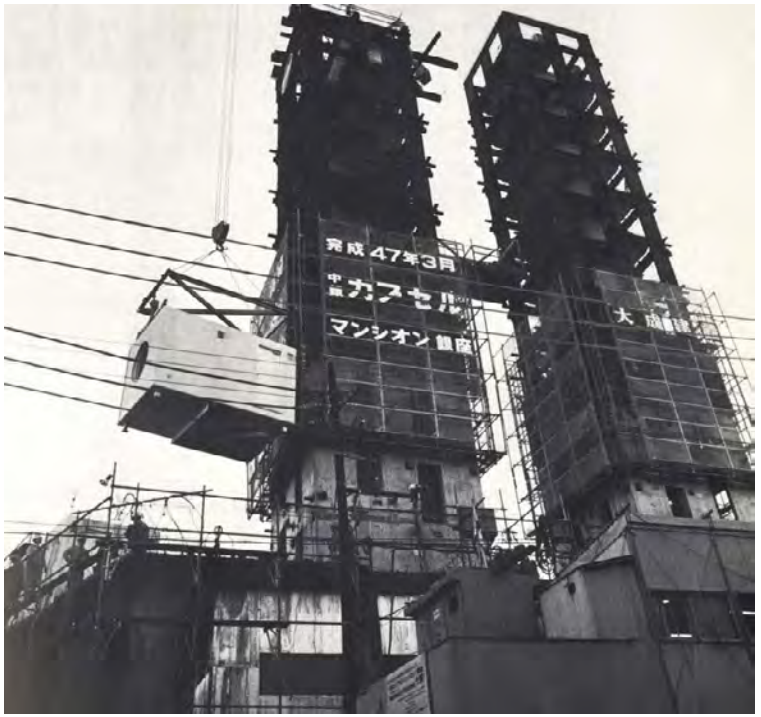


"...A CONCEPT OF INCOMPLETENESS; GROWTH AND CHANGE WITH INTUITIVE WHOLENESS; NOT A THEME OF ACADEMIC PRECISION AND LOGIC. **KUROKAWA'S PHILOSOPHY** IS IN DIRECT CONTRAST TO THE WESTERN IDEA OF DETERMINISM AND INEVITABILITY." [101]

NAKAGIN APARTMENT, JAPAN 1971, KUROKAWA

"THE CONCEPT OF METABOLISM IS NOTHING BUT A SENSE OF **IMPERMANENCE**." [101]

"THE POTENTIAL OF KUROKAWA LIES IN HIS AWARENESS OF **CHANGE AND** UNDERSTANDING OF HIS **TIME**, IN WHICH A MULTITUDE OF FORCES CO-EXIST." [101]



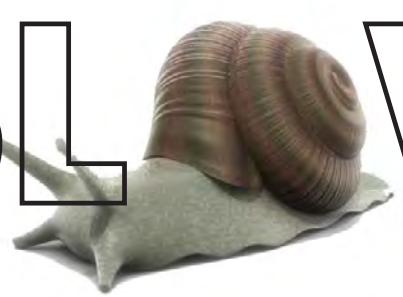
NAKAGIN APARTMENT, JAPAN 1971, KUROKAWA

"IT IS IMPORTANT OT NOTE THAT THE NEW BREED OF LEADING JAPANESE ARCHITECTS IS PREDISPOSED TO FACE THE CHANGING WORLD WITH A BROAD-MINDED, ALL-EMBRACING ATTITUDE, WHICH MAY NOT ALLOW THEM TO CONTROL EVERYTHING, BUT AT LEAST WILL ALLOW THEM **TO CONTROL THE FOUNDATION**, WHICH CAN **THEN SHAPE THEIR PHYSICAL ENVIRONMENT**." [101]

13. Helix City, 1961, Kisho Kurokawa

Koolhaas, Rem. "Bigness", S, M, L, XL, pp. 494-517
Uesaka, Yasuo. "Kurokawa, A review of his Metabolist philosophy and arts since Expo '70", Architecture Plus, Jan./Feb. 1974, pp. 96-107

SUSTAINABILITY IS...

SL  W

AVG PAYBACK: 7-10 YEARS http://solarelectricfreedom.com/financials/solar-payoff-period

TO GENERATE 1 MILLION MEGAWATTS OF POWER YOU NEED 61,800,000 ACRES [1,000,000 TURBINES]
OR 200 ROWS OF TURBINES SPACED 1/2 KILOMETER APART FROM MAINE TO MIAMI
http://www.creativeenergyalternatives.com/wind/how_many_wind_turbines.html

FRANK GEHRY ON LEED

THE EXPENSE OF BUILDING TO LEED STANDARDS OFTEN OUTWEIGHS THE BENEFITS. ON SMALLER PROJECTS, HE SAID, **"THE COSTS OF INCORPORATING THOSE KIND OF THINGS DON'T PAY BACK IN YOUR LIFETIME."**
http://www.businessweek.com/innovate/next/archives/2010/04/architect_gehry.html

HOW CAN WE MAKE SUSTAINABILITY...

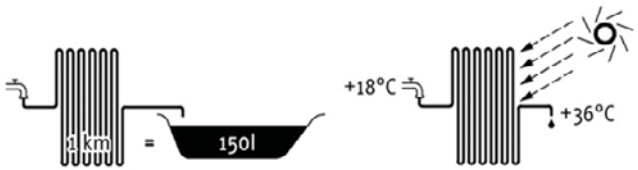
EFFICIENT?

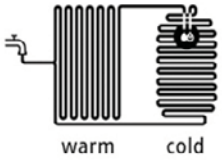
EFFECTIVE?

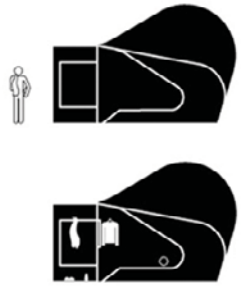
BEAUTIFUL?

BATH IS COMPOSED OF A 1,000-METER GARDEN HOSE THAT PLUGS VIA A HYDRANT INTO THE EXISTING HIDDEN INFRASTRUCTURE AND CAN CARRY ENOUGH WATER TO FILL A BATHTUB FOR TWO PEOPLE. ARRANGED IN COUNTLESS LOOPS, THE ELASTIC HOSE FORMS THE SURFACE OF A SCREEN THAT CATCHES THE SUN, THUS HEATING THE WATER IN THE HOSE THAT WILL FILL THE BATH AND EVENTUALLY BE RELEASED TO IRRIGATE THE SURROUNDINGS.

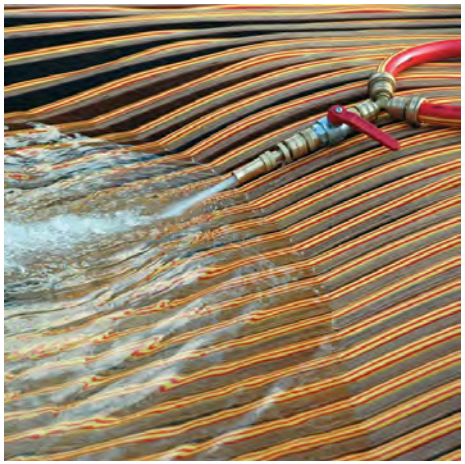
PRECEDENT 1: BAD [BATH]_SMAQ

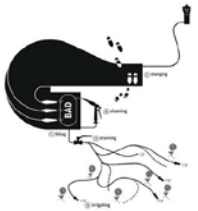


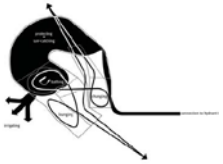




1. 1 km of hose contains a bathtub of water
2. Solar energy as heating device
3. Two Circuits
4. Occupied - non occupied





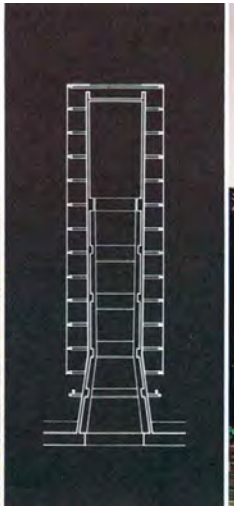


DURING THE DAY THE TOWER OF WINDS STANDS AS A 21M TALL OPAQUE OBJECT, ITS ALUMINUM CLADDING SHIELDING THE MIRRORED PLATES AND LIGHTS WITHIN. AT NIGHT THE LIGHTS AND REFLECTIVE SURFACES DANCE TO THE MUSIC OF THE CITY, COMPUTER-CONTROLS REACTING TO BOTH MAN-MADE AND NATURAL FORCES: AMBIENT SOUNDS, WIND FORCES, TIME OF DAY AND SEASON. THE IMAGES THAT FOLLOW ILLUSTRATE THE VARIETY OF PATTERNS AND DEGREES OF TRANSPARENCY ACHIEVED BY A COMBINATION OF OVER 1,000 LAMPS, TWELVE NEON RINGS, AND THIRTY FLOOD LIGHTS, THE LAST SITUATED ON THE GROUND AND DIRECTED UPWARDS WITHIN THE TOWER. ITO CREATED A WORK OF ART/ARCHITECTURE OF SIMPLICITY THAT REFLECTS THE COMPLEXITY AND NATURE OF THE CITY AND ITS INHABITANTS. HIS INFLUENCE IS THE MUSIC OF THE ENVIRONMENT COMBINED WITH OUR INTERACTION AND EFFECT UPON IT.

PRECEDENT 2: TOWER OF WINDS_TOYO ITO


日本生命
横浜三越


National

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programming part 2:

Looking at Yokohama International Port Terminal in Yokohama, Japan by Foreign Office Architects; I based some of my program on the existing program in Yokohama as well as the current program at the Troncetto in Venice, Italy.

Ground Floor

1. Covered Parking Terminal [4000 spaces]
2. Service Spaces [20% of total floor area]
3. Egress
4. Cab Valet [1 lane track]
5. Bus Pick Up [1 lane track]

Approximate Floor Area: [1.8 Million S.F.]

Second Floor

6. Service Spaces [20% of total floor area]
7. Cafes [2 at separate terminals]
8. Restaurants [2 at separate terminals]
9. Shops [travel, souvenirs, news, etc]
9b. Kiosks [possibly]
10. Bag Check [departure/arrival, luggage storage]
11. Seating [departure/arrival, resting areas]
12. Access to Park [elevators, fire stairs, grand entrances, secondary access]
13. Conference Halls [Events/Exhibition Halls,Gallery]

Third Floor

13. Water Folly*
14. Wind Folly*
15. Light Wells [into major spaces]
16. Park Seating [spectator deck, garden, market]
17. Observation Platforms [incoming/outgoing]
18. Event Plazas [theater]
19. Soccer Field [theater seating, locker rooms]

W a t e r
F o l l y

1. Allowable Water Storage
2. Steam Room
3. Storage and Energy: Consumption and Release
4. Steam and Light Void

W i n d
F o l l y

1. Mechanical Room
2. Experience Deck
3. Storage and Energy: Consumption and Release

PROJECT STATEMENT

WHAT IS A FOLLY? THEY HAVE NO PURPOSE OTHER THAN AS AN ORNAMENT. THEY ARE BUILDINGS, OR PARTS OF BUILDINGS. THEY ARE PURPOSE-BUILT. THEY ARE OFTEN ECCENTRIC IN DESIGN OR CONSTRUCTION. THERE IS OFTEN AN ELEMENT OF FAKERY IN THEIR CONSTRUCTION. THEY WERE BUILT OR COMMISSIONED FOR PLEASURE. **A FOLLY COULD BE ANYTHING, OR IT COULD BE NOTHING. I THINK IT SHOULD BE SOMETHING. I WANT TO DESIGN A FOLLY THAT REACHES FURTHER THAN ITS NAME.** *WHAT IS A FOLLY?* **OR WHAT COULD IT BE?** *IT* **COULD BE A BEACON FOR SUSTAINABILITY. IT** *WILL* **BE A BEACON FOR SUSTAINABILITY, COMMUNICATING ITS VERY PURPOSE THROUGH SMART DESIGN AND PURPOSEFUL DECISIONS WHICH WILL ULTIMATELY** *EDUCATE* **THOSE WHO EXPERIENCE IT. AND I THINK THIS FOLLY WILL BEST COMMUNICATE ITS PURPOSE INSIDE A PARK. SO A FOLLY [***FOR PURPOSE***], DESIGNED TO UTILIZE THE ELEMENTS, AND COMMUNICATE IT'S STRATEGIES [***IN MOTION***], ALL WITHIN A DESIGNED SELF-SUSTAINABLE PARK.**

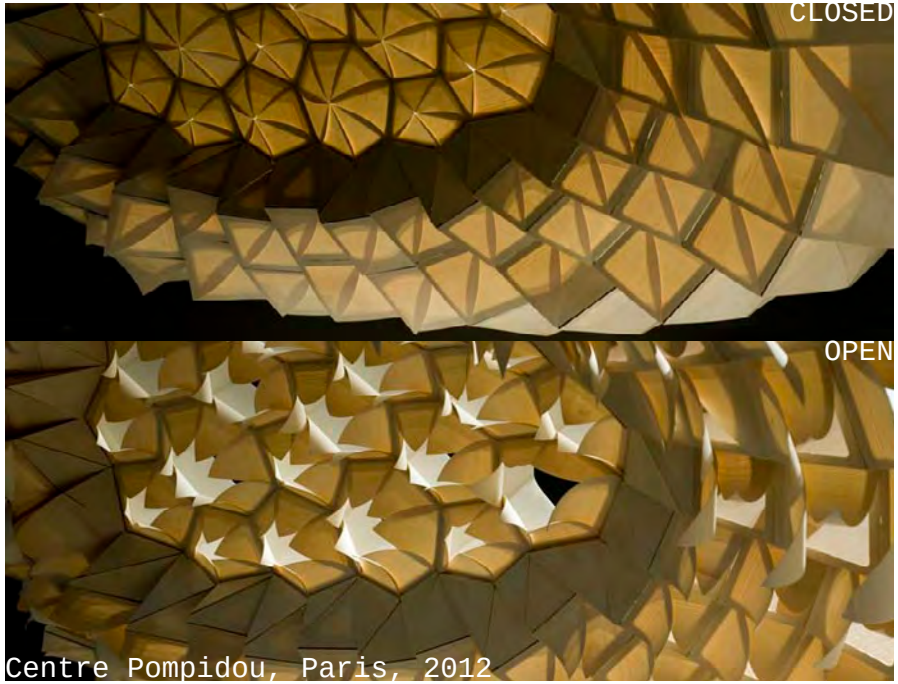
THEMATIC PRECEDENT:

HYGROSCOPE – METEOROSENSITIVE MORPHOLOGY

Achim Menges in collaboration with Steffen Reichert, Centre Pompidou, Paris, 2012

The project explores a novel mode of **responsive architecture** based on the combination of material inherent behaviour and computational morphogenesis. The dimensional instability of wood in relation to moisture content is employed to construct a **climate responsive architectural morphology**. Suspended within a humidity controlled glass case the model opens and closes **in response to climate changes** with no need for any technical equipment or energy. Mere fluctuations in relative humidity trigger the silent changes of material-innate movement. **The material structure itself is the machine.**

Centre Pompidou, Paris, 2012



THEMATIC PRECEDENT:AS FOLLY

HYGROSKIN – METEOROSENSITIVE PAVILION

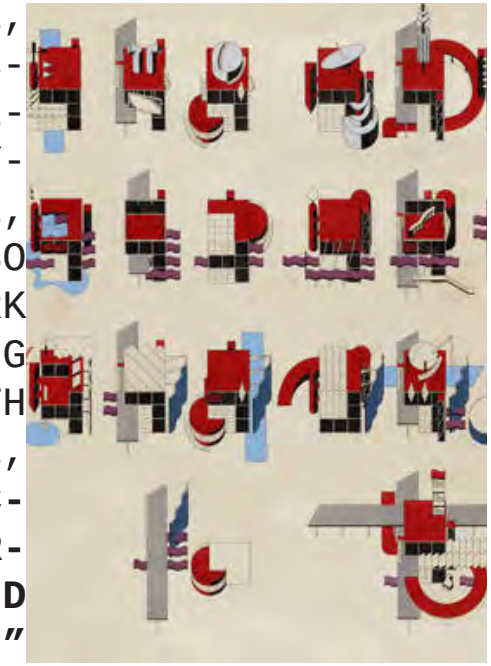
Permanent Collection, FRAC Centre Orleans, France, 2011-13
Achim Menges in collaboration with Oliver David Krieg and Steffen Reichert

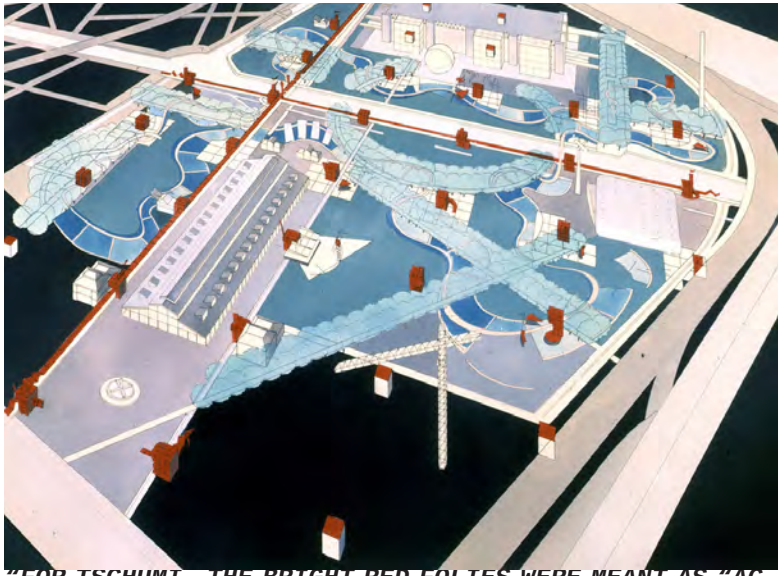
FRAC Centre Orleans, France, 2011-13
http://vimeo.com/73727749

PROGRAMMATIC PRECEDENT:

PARC DE LA VILLETTE
PARIS, FRANCE 1983-1989
BERNARD TSCHUMI

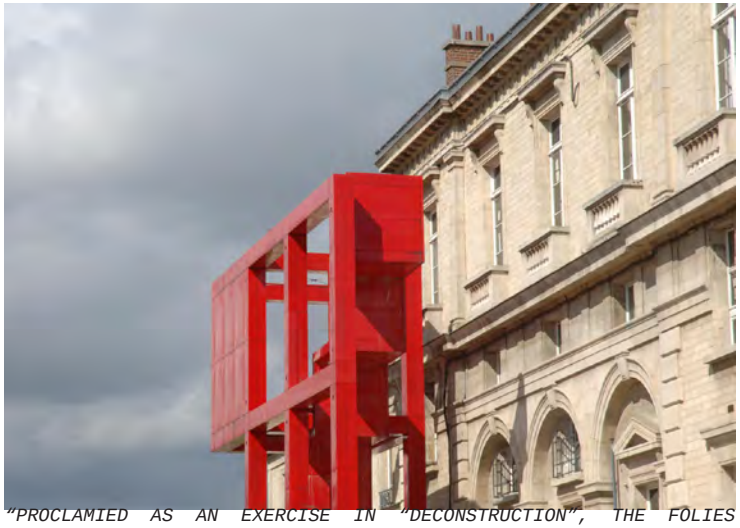
“INFORMATION-FOLIE, TICKET-FOLIE, MUSIC-FOLIE, BELVEDERE-FOLIE, OBSERVATORY-FOLIE, STAIR-FOLIE, CLOCK-FOLIE, AND SO ON: FROM THE PARK ENTRANCE AND ALONG THE ENTIRE LENGTH OF THE PROMENADE, **THE BUILDINGS OCCUPY SPACE, GENERATE MOVEMENT, AND AMPLIFY ACTION.”**





“FOR TSCHUMI, THE BRIGHT RED FOLIES WERE MEANT AS “ACTIVATORS OF SPACE” RATHER THAN AS SCULPTURAL OBJECTS.”

“THE FOLLES ARE MULTIFUNCTIONAL, NON-FUNCTIONAL, OR DESIGNED TO OCCASIONALLY “COLLIDE WITH” OR “RESPOND TO” OTHER FACILITIES.”



“PROCLAMIED AS AN EXERCISE IN “DECONSTRUCTION”, THE FOLIES CHANGE ACCORDING TO THEIR ASSEMBLAGE AND TOPOGRAPHICAL POSITIONS. BUT TO LIMIT THEM TO THESE PARAMETERS ALONE WOULD DISREGARD THE CONSTANT TRANSFORMATION OF THEIR APPEARANCE BY THE SEASONS AND THE HOURS, LIGHT AND SHADE, NIGHT AND DAY.”

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